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RUBY DAM

MANUAL FOR OPERATION AND MAINTENANCE

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**State Water Project Bureau
Water Resources Division
Department of Natural Resources and Conservation
48 North Last Chance Gulch
P.O. Box 201601
Helena, MT 59620-1604**

**Initial Publication December 1993
Reprinted July 2001**

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OVERVIEW

Ruby Dam is located in Madison County about six miles south of Alder on the Upper Ruby Road. The reservoir is fed primarily by the Ruby River which originates in the Snowcrest and Gravelly Ranges, about 30 miles south of the dam (see Figures 1 and 2). Figure 3 provides a general layout of the dam, spillway and outlet works. Figure 4 shows the location of the monitoring wells.

The dam is owned by the Montana Department of Natural Resources and Conservation (DNRC) and is managed by the State Water Projects Bureau (SWPB) of the DNRC. The Ruby River Water Users Association (here in called "association") operates maintains the dam.

The earthfill dam was completed in 1938. Ruby Dam is 111 feet high and 846 feet long. The reservoir stores 36,663 acre-feet at the spillway crest, 37,612 acre-feet at the top of the flashboards, and 56,355 acre-feet and the dam crest.

The dam's outlet works consist of a wet tower with a 72-inch diameter cast iron gate valve upstream from a 72-inch diameter butterfly valve used for flow control. The butterfly valve's control is at the top of the tower while the gate valve is controlled at the bottom of the tower. There is a spring in the left abutment the is piped to the outlet works.

The concrete spillway, located in the right abutment, has an ogee crest. The spillway is 125 feet wide at the top, has flash boards, and tapers to 75 feet at the bottom with a flipbucket for energy dissipation. There is a six inch drain pipe in the middle of the spillway that exits where the flipbucket starts. The spillway

has a capacity of 36,000 cubic feet per second (cfs) without flashboards and 32,400 cfs with the flashboards.

Water from the reservoir is delivered to purchasers through two association-owned canals: the West Bench Canal, 12 miles long with a capacity of 85 cfs, and the Vigilante Canal, 26 miles long with a capacity of 115 cfs.

Water from the reservoir is primarily used for agricultural irrigation. The reservoir is also used for water-based recreation and regulation of stream flows.

At some point on September 1, 1994, the reservoir was completely drained. The river flowing through the reservoir began to erode a channel through the sediment in the bottom of the reservoir and a large amount of sediment was discharged into the river below the reservoir outlet resulting in a large fish kill. A task force was appointed by the Director of the DNRC to develop a minimum reservoir pool size, reservoir operation guidelines, river dewatering prevention plan, and a water delivery plan. In May, 1995, a consent decree was negotiated by DNRC, Department of Environmental Sciences and the association which describes the steps which would be taken to address the water quality violations that occurred when the reservoir was drained. A copy of the Consent Decree and the reservoir operating guidelines adopted by the Ruby River Reservoir Task Force are shown in Appendix A.

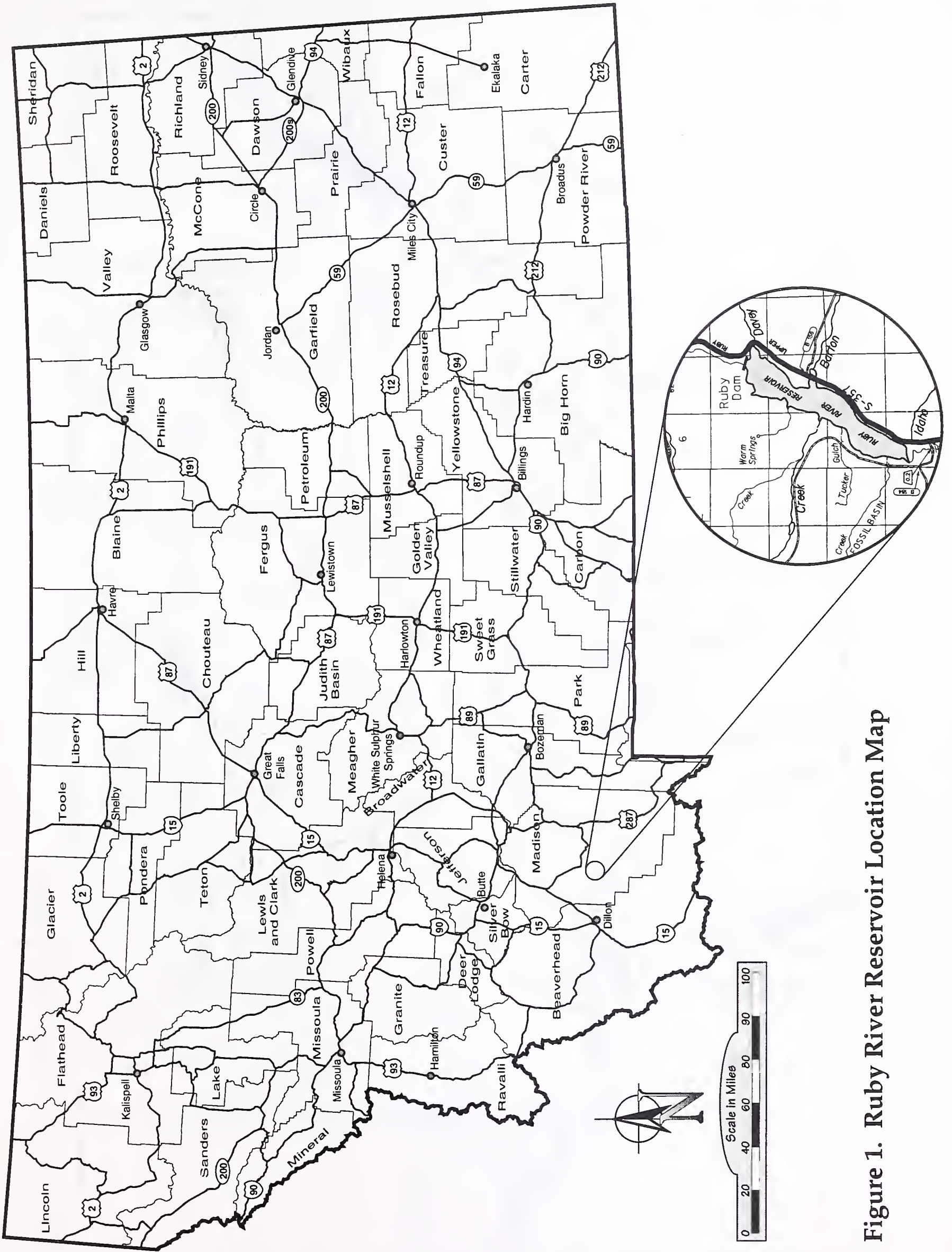


Figure 1. Ruby River Reservoir Location Map

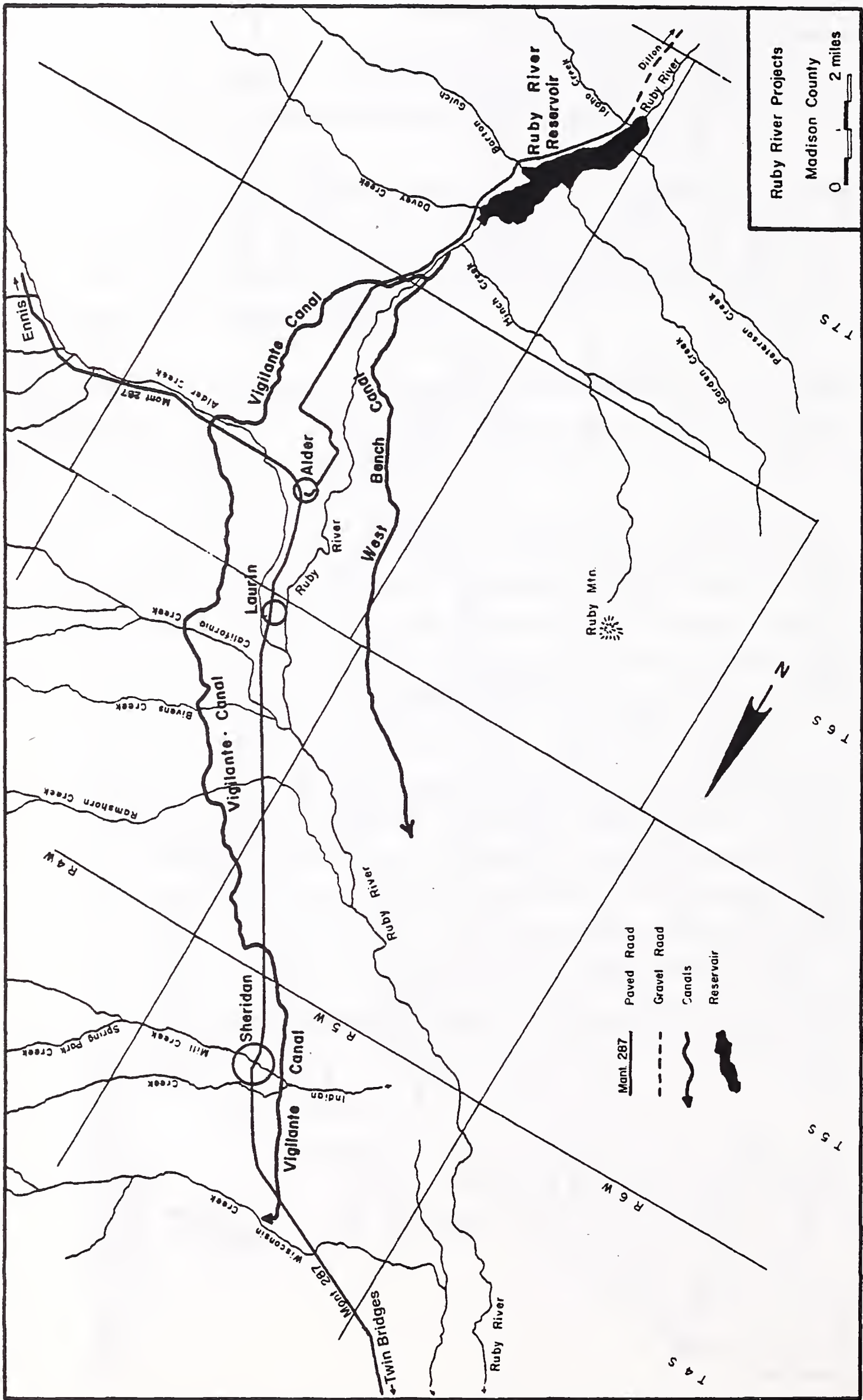


Figure 2. Ruby River Project Map

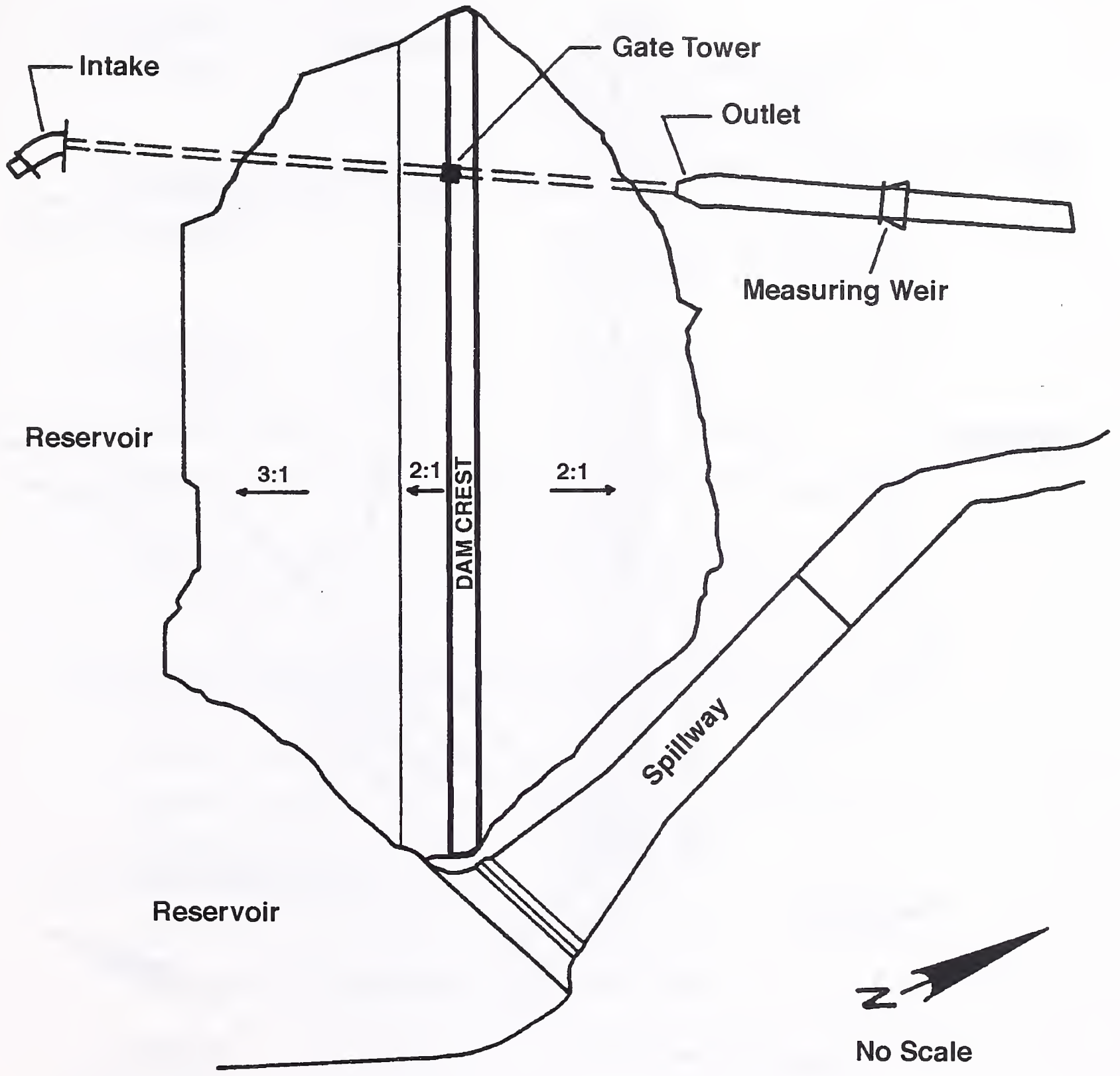


Figure 3. Ruby River Dam General Layout

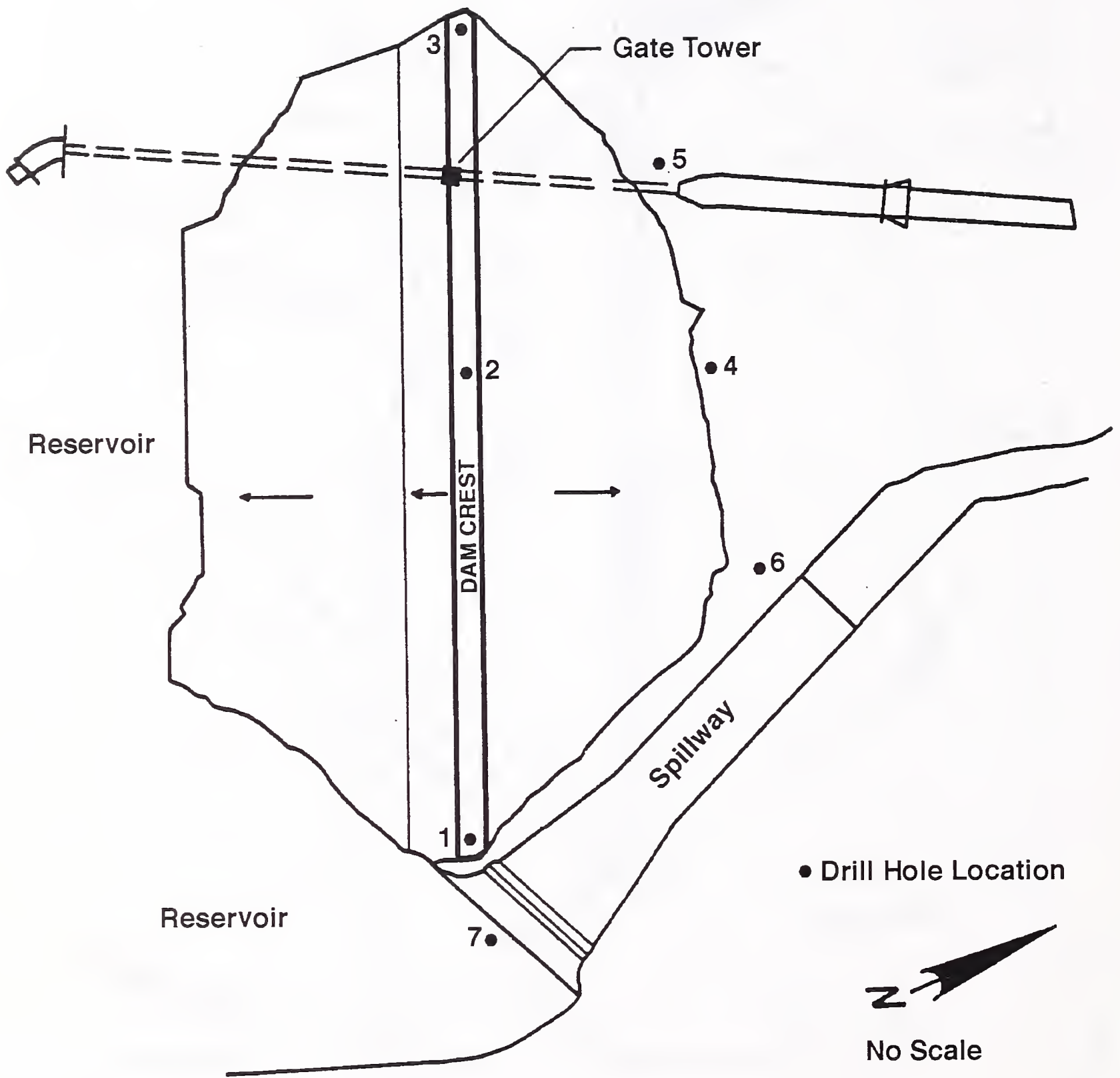


Figure 4. Ruby Dam Monitoring Wells Location

STATISTICAL INFORMATION

1. General

- | | |
|-----------------------|---|
| a. Owner | Montana Department of Natural Resources and Conservation (DNRC) |
| b. Operator | Ruby Water Users Association |
| c. Location | Section 29, Township 3 South, Range 4 West (dam location) |
| d. Latitude | 45° 14' 06" |
| Longitude | 112° 06' 42" |
| e. County--State | Madison--Montana |
| f. Watershed Location | Ruby River, Jefferson River Basin |
| g. Drainage Area | 595 square miles |

2. Principal Elevations (feet above mean sea level)

- | | |
|--------------------------------------|---------------|
| a. Minimum Dam Crest | 5409.2 feet |
| b. Normal Full Pool | 5,392.97 feet |
| c. Spillway Crest | 5,392.0 feet |
| d. Spillway Crest (with flashboards) | 5,392.97 feet |
| e. Toe of Dam | 5,299.0 feet |
| f. Outlet Works Intake Invert | 5298.0 feet |

3. Reservoir

- | | |
|---|-----------|
| a. Length of Maximum Pool (approximate) | 3.3 miles |
| b. Maximum Reservoir Level of Record (May 13, 1984) | 5,395.3 |
| c. Surface Area (at normal full pool) | 970 acres |

4. Storage

- | | |
|--|------------------|
| a. Maximum Storage (pool at dam crest) | 56,355 acre-feet |
| b. Active Storage (pool at flashboard crest) | 37,611 acre-feet |
| c. Active Storage (pool at spillway crest) | 36,633 acre-feet |
| d. Maximum Surcharge (from spillway flashboard crest to dam crest) | 18,744 acre-feet |

5. Hydrology

- | | |
|--|------------------------------------|
| a. Probable Maximum Flood (PMF) (March, 1993) | 117,200 cfs (470,400 acre-feet) |
| b. 100-year Return Period Flood | 3,427 cfs |
| c. 500-year Return Period Flood | 5,440 cfs |
| d. Maximum flow of record (1938-1992) at USGS Gage 06019500, just upstream from reservoir | 3,810 cfs |

6. Embankment (Dam)

- | | |
|--|-----------|
| a. Type | Earthfill |
| b. Hydraulic Height | 111 feet |
| c. Crest Length | 846 feet |
| d. Crest Width | 25 feet |
| e. Downstream Slope | 1v on 2h |
| f. Upstream Slope (above 5392.0 feet) | 1v on 2h |
| g. Upstream Slope (below 5392.0 feet) | 1v on 3h |

7. Outlet Works

- a. Size 90-inch concrete straight-legged horseshoe
- b. Length 635 feet
- c. Control 72-inch diameter slide gate (emergency gate) upstream from a 72-inch butterfly valve (operating gate). Both gates are operated from the top of a 96-inch diameter concrete wet tower.
- d. Capacity (pool at dam crest) 1,750 cfs
- e. Trashrack Yes

8. Spillway

- a. Location Right Abutment
- b. Type Uncontrolled ogee (under normal operation a nominal 1-foot flash board is placed across the crest of the ogee)
- c. Width 125 feet
- d. Length 361 feet
- e. Capacity (pool at spillway crest without flashboards) 36,000 cfs
(pool at spillway crest with flashboards) 32,400 cfs

OPERATING PROCEDURE

The Ruby River Water Users Association operates Ruby Dam and Reservoir to insure safe operation of the project, and to provide an adequate supply of irrigation water to meet contracts with water users without exceeding safe storage or flow levels.

METHOD AND SCHEDULE OF OPERATION

The association's goal is to have the reservoir full before contract holders start putting in calls for water. The reservoir fill almost every year.

The date of irrigation releases varies from year to year, with May 1 typically being the earliest. Irrigation releases from the reservoir usually end by September 30 as specified in the water purchase contracts. The actual dates that releases begin and end depend on a year's actual climatological and hydrological conditions.

Water is also released from the reservoir to help regulate instream flows for fishery purposes. These releases depend on the yearly flow conditions in Ruby River.

The Ruby River Reservoir Task Force adopted a final Reservoir Operating Guidelines in May 1995 which spells out guidelines for the operation of the project to minimize dewatering of the reservoir and the river below the dam. A copy of the guidelines is in Appendix A.

Maximum Winter Storage: The maximum reservoir elevation for winter storage is 5,371 feet with 19,294 acre-feet of storage. This winter maximum helps prevent damage to the riprap

and embankment from the wind-driven waves and ice.

Minimum Winter Storage: The minimum reservoir elevation for winter storage is 5,330.27 feet with 2,600 acre-feet of storage. The minimum level helps protect the fishery in the reservoir, helps prevent sediment from being washed downstream, and helps prevent ice damage to the inlet structure for the outlet works.

Minimum Outlet Discharge: A minimum flow of 800 to 1,200 miner's inches (20 - 30 cfs) must be maintained at the dam outlet.

SAFE DRAWDOWN

Since the stability of Ruby Dam has not been thoroughly investigated the SWPB recommends that down rate not exceed one foot per day.

LIMITATIONS OF APPURTENANCES

Appurtenances at Ruby Dam include the spillway, outlet works and delivery canals. The maximum capacity of the outlet works is 1,750 cfs at the minimum dam crest elevation. The flow through the outlet works should be limited to a maximum of 600 cfs for short duration flows, and 450 cfs for long duration flows. These flows are to minimize damage to the outlet stilling basin. In addition the spillway will discharge 36,000 cfs with the reservoir water elevation at the minimum dam crest, without the flashboards in place. The spillway capacity with the flashboards in place is 32,400 cfs. The spillway rating table is shown in Appendix B.

DAM OPERATOR

The responsibility for the daily operation of the dam and reservoir rests with the association and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's goal of providing adequate water to satisfy water purchase contract's without exceeding safe storage or flow levels. The dam operator's specific responsibilities are to:

1. Operate the mechanical features of the outlet works
2. Coordinate filling of the reservoir and the release of water
3. Notify the SWPB of any unusual occurrences such as vandalism, impending floods, structure failure, or excessive seepage.
4. Perform certain maintenance tasks
5. Monitor weather conditions
6. Monitor seepage

Typically, the out-going dam operator, the association, and the SWPB train a new operator. The dam operator's training focuses on the mechanical operation of the gates, measurement of the storage levels, measurement of the rate of water releases, daily observation of unusual conditions, and record-keeping. The outlet gates are operated by a portable electric pipe threading tool, fitted with an adapter to fit the gate operating shaft. If necessary, the gates can be operated manually with a hand crank.

The outlet works are intended to be for controlling the release of irrigation water and not for providing emergency relief.

The dam operator normally is available daily to observe the dam and perform operating functions daily during the filling and irrigation seasons. At other times of the year the dam operator is available weekly or monthly. The dam operator lives downstream of the reservoir, within site of the dam. Any changes to the dam

crest, faces of the dam, or the outlet structure will be visible to the dam operator.

Communication among the dam operator, the association, and the SWPB typically takes place by telephone. During emergencies or unusual occurrences, radio communication may be established so that the dam operator can speak directly with county authorities and communicate indirectly with the SWPB (**see *Ruby Dam Emergency Plan***).

STORAGE DETERMINATION

Storage in the reservoir and the elevation of the reservoir surface are determined by taking a slope measurement. Measure in feet from the rebar pin to the water surface. The 0+00 pin is located approximately 50 feet east of the gravel access road to the dam, below the parking lot along the paved highway, and about 8 feet above the eroded bank. The elevation of the reservoir surface and the storage can then be found using the Slope-Elevation-Storage Table in Appendix B.

When the reservoir is at or below 7,500 acre-feet (Elevation 5346.7 feet), the alternate Slope-Elevation-Storage Table in Appendix B should be used. The 0+00 pin is located 48.5 feet on a magnetic heading of 240 degrees from a fiberglass fence post located at the base of the rock outcrop that forms the flat area in front on the spillway. The slope pin alignment is 240 degrees magnetic.

INFLOW AND OUTFLOW MONITORING

Current inflows into the reservoir and outflows from the reservoir can be found under the Upper Missouri River Basin portion of the following USGS internet site:

http://montana.usgs.gov/rt-cgi/gen_tbl_pg

USGS gage 06019500, Ruby River Above Reservoir, monitors current inflows into the reservoir. The gage is located on the right bank at the county road bridge 0.7 miles downstream of Mormon Creek and 4.2 miles above the reservoir.

USGS gage 06020600, Ruby River Below Reservoir, monitors current outflows from the reservoir. The gage is located on the right bank 0.2 miles downstream of the dam.

WEATHER MONITORING

The dam operator monitors weather conditions through local weather forecasts and the National Weather Service (NWS).

If severe flooding is anticipated, the NWS Great Falls Office **(406-453-2081 or 406-453-4561)** should be contacted for information about the storm, such as the estimated storm intensity and duration, runoff duration (above base flow), and total flood volume of the storm in the Ruby Creek drainage.

Current snow water equivalent and total precipitation can be monitored at three SNOTEL sites located above the reservoir -- Divide, Clover Meadow, and Short Creek. The information for these three sites can be accessed under the Jefferson River Basin portion of the following USDA internet site:

<ftp://ftp.wcc.nrcs.usda.gov/data/snow/update/mt.txt>

Additional information about historical snowpack, precipitation, maps and graphs can be accessed at the following internet site:

<http://www.mt.nrcs.usda.gov/swcs/snow/snow.html>

INTERACTION WITH OTHER DAMS

Except for irrigation diversion dams, Toston Dam and Canyon Ferry Dam are the next dams downstream from Ruby Dam. The safety of these dams is not affected by the normal operation of Ruby Dam. Therefore, interaction with other dams is not a concern of the normal operation of Ruby Reservoir.

EMERGENCY

If it appears that Ruby Dam about to breach, or during emergency operations, the dam operator should initiate the **Ruby Dam Emergency Action Plan** and notify the operators at Toston Dam (**406-266-3869**) and Canyon Ferry Dam (**406-475-3310, ext 200**) so that they can initiate their Emergency Plans.

INSPECTION AND MONITORING

The SWPB inspects the dam annually. Appendix C includes an example of a SWPB inspection report form. In addition to annual inspections, SWPB personnel will inspect the dam and reservoir during and after heavy runoff and after severe rainstorms and windstorms, during high storage periods, and after an earthquake. The embankment is not monitored by instrumentation.

STRUCTURAL FEATURES INSPECTION

Structural features include the embankment, gatehouse, outlet works, and spillway (Figure 3). The SWPB inspects these structures annually as part of its inspection program. Items to be checked or noted include, but are not limited to:

1. Embankment
 - a. Erosion gullies in dam embankment and dike faces.
 - b. Damage from burrowing animals or vegetation
 - c. Displacement or loss of riprap protection
 - d. Displacement of fill, sink holes, slumps, or other items
 - e. Any seepage on downstream face or base of embankment
2. Gate House -- any damage or vandalism
3. Outlet Works
 - a. Any differential settlement or movement resulting in cracking of the conduit
 - b. Erosion of the seals or concrete by cavitation immediately downstream of the gates
 - c. Major seepage of water into the conduit
 - d. Major deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
 - e. Operation of both gates through a full cycle

- f. Air vent for free, unobstructed operation
 - g. Corrosion of any metal
 - h. Proper lubrication and cleaning of pedestals for
4. Spillway
- a. Deterioration of concrete
 - b. Separation or movement of joints
 - c. Erosion of the spillway chute, backfill behind the walls, or stilling basin
 - d. Blockage of the approach or exist channel
 - e. Blockage of the drains

RIPRAP INSPECTION

The riprap along the face of the dam should measure at least 30 inches thick. Immediately after the occurrence of high water, SWPB personnel will inspect the riprap and determine if additional riprap is needed.

MONITORING WELLS

The dam has seven monitoring wells that were drilled in the fall of 1999. Three monitoring wells are located along the crest of the dam, three along the downstream toe of the dam embankment, and one in the approach channel to the spillway approximately 30 feet upstream of the spillway (see Figure 4). Generally, two piezometers were installed in each monitoring well. Soil profiles of the drill holes and details as to how the wells were constructed are shown in Appendix E.

SEEPAGE MONITORING

There are no visible downstream seeps below the dam. There are two drains located in the spillway which flow when the

reservoir pool is near the spillway crest. Also, the joints in the two lower right spillway floor slabs seep water when the reservoir pool is near the spillway crest elevation. The weep holes in the spillway flipbucket appear to be flowing, but the rate cannot be determined because the water in the flipbucket submerges the drains.

The 6-inch diameter drain in the left wall of the outlet tunnel flows continually, but the quantity of the flow can not be determined. The drain is difficult to measure due to its location in the outlet tunnel floor. This drain was installed to drain a spring that was discovered during construction of the dam. All of the drains are flowing clear water. To date, no measuring devices have been installed on any of the drains.

The monitoring wells and seepage areas at the dam are observed and monitored by the dam operator, DNRC Bozeman Regional Office, and SWPB during regular visits; and may be measured by the SWPB during annual inspections. The instruments are generally measured twice per month from May 1 to August 31, and once per month in March, April, September, and October. Measurements may be taken during the winter months (November, December, January, February) depending on weather conditions. The monitoring data is maintained by the SWPB in Helena.

MAINTENANCE

The association is responsible for the project's routine maintenance. In addition, the SWPB may identify items that need maintenance or repair during the annual inspection.

ROUTINE MAINTENANCE

To protect the dam and keep it in good working order, the dam operator during regular visits to the dam will watch for and identify any potential maintenance requirements. As soon as a need is identified, the dam operator or association needs to schedule and perform the routine maintenance.

Items that may need occasional attention include, but are not limited to:

1. *Lubrication and cleaning of gate-operating mechanisms.*
2. *Debris or silt restricting the spillway inlet.* Accumulated debris that could affect the spillway operation should be removed at once, with all debris removed at least annually.
3. *Erosion gullies on embankment.* Development of erosion gullies should be checked immediately. Gullies will be filled, compacted, and seeded. Particular attention will be paid to the abutment contact areas and the downstream dam face
4. *Rodent damage.* The rodents will be removed or destroyed and any burrows holes should be filled immediately.
5. *Upstream slope riprap.* Reservoir riprap normally will be observed annually, but may occasionally need repairs due to high water or wave action.
6. *Vegetative cover on downstream slopes.* Good vegetative cover must be maintained, but large brush should be removed.

7. *Noxious weeds.* Noxious weeds on and around the dam embankment and around the reservoir should be sprayed at least on an annual basis.
8. *Clean spillway and outlet structure wall tops.* Spillway and outlet structure wall tops should be clear of any dirt, grass, brush, and any overhanging vegetation or trees.
9. *Repair joints and seal cracks in the spillway and outlet structure.*
10. *Large measuring weir below outlet.* This device will be maintained clean of sediment, algae, free flowing, free of debris, riprap above and below the weir will be maintained. The old pipe measuring device will remain covered.

ANNUAL MAINTENANCE

The SWPB conducts annual inspections of Ruby Dam and reservoir. During these inspections, any items requiring annual maintenance will be identified and recorded. Items that may need annual maintenance include the dam embankment, spillway, outlet works, gates, riprap, roads, large measuring weir, and gatehouse. Other routine items needing immediate attention, such as the need to remove trees or brush, will also be noted.

After the inspection, SWPB sends the association a Dam Safety Inspection Report and a Maintenance Schedule Report. The reports identify items that need maintenance and provide a schedule of when the maintenance tasks need to be completed. The association is responsible for performing the maintenance items with the times specified

The dam operator or association members may perform the maintenance tasks. However, major repairs will likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

RECORD-KEEPING

The SWPB maintains records, including photographs, of all inspections and maintenance requirements. These records also include seepage monitoring observations. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in downtown Helena.

The dam operator will keep records of the reservoir elevation, seepage observations or measurements, monitoring wells, and any unusual conditions. These records may be review at the dam operator's house.

REFERENCES

- CH2M Hill April 1980. Phase 1 Inspection Report, National Dam Safety Program, Ruby Dam, Alder Montana, Madison County, MT-4. Prepared for the State of Montana (DNRC) under the U.S. Army Corps of Engineers National Dam Safety Program.
- Soil Conservation Service. May 1986. Ruby River Reservoir Operating Guide. Prepared for the State of Montana (DNRC) and Ruby River Water Users Association by the U.S. Department of Agriculture, Soil Conservation Service, Bozeman, Montana.
- Omang, R.J. July 1992. Analysis of the Magnitude and Frequency of Floods and the Peak-Flow Gaging Network in Montana. U. S. Geological Survey, Water-Resources Investigations Report 92-4048.
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- Todd, Neil; Dam Operator. Personal communication. November 1993.
- Ruby River Task Force. June, 1995. Ruby River Reservoir Task Force Final Report.
- Parish, Lovell, Regional Geologist. 1998. Geotechnical Inspection of Ruby Dam - Madison County, Montana. Prepared for the State of Montana (DNRC) by the Bureau of Reclamation, Great Plains Office, Billings Regional Office, Montana.

APPENDICES

APPENDIX A

CONSENT DECREE
AND
RESERVOIR OPERATING GUIDELINES

COPY

NANCY SWEENEY
CLERK-DISTRICT COURT

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DEPUTY

MONTANA FIRST JUDICIAL DISTRICT COURT
LEWIS AND CLARK COUNTY

STATE OF MONTANA ex rel.
DEPARTMENT OF HEALTH AND
ENVIRONMENTAL SCIENCES,

Plaintiff,

v.

STATE OF MONTANA, DEPARTMENT
OF NATURAL RESOURCES
AND CONSERVATION and RUBY
RIVER WATER USERS ASSOCIATION,

Defendants.

Cause No. ADV-95 640

CONSENT DECREE, JUDGMENT, AND ORDER

The Plaintiff, State of Montana ex rel. Department of Health and Environmental Sciences (hereinafter "Plaintiff" or "DHES"), represented by Claudia Massman, Special Assistant Attorney General, and the Defendants, Montana Department of Natural Resources and Conservation, (hereinafter "DNRC"), represented by Donald MacIntyre, Chief Legal Counsel of DNRC,

(CONSENT DECREE, JUDGMENT AND ORDER)

1 and the Ruby River Water Users Association, (hereinafter
2 "RRWUA"), represented by Russ McElyea of the law firm of
3 Moore, O'Connell & Repling, have stipulated and agreed to the
4 entry of the facts and terms within this Consent Decree. The
5 Court, being otherwise fully informed in the matter, hereby
6 approves the parties' stipulations and adopts the following
7 Stipulations as its Findings of Fact and Conclusions of Law
8 as set forth in this Consent Decree.

9
10 STIPULATIONS

11 A. Jurisdiction

12 1. The DHES filed a Complaint in this matter on May 25,
13 1995.

14 2. The parties agree that this Court has jurisdiction
15 over the subject matter of this action and over the parties
16 to this action. Defendants acknowledge the requirements of
17 service are satisfied according to Rule 4D, M.R.Civ.P.

18 B. Objectives

19 3. The DHES, DNRC, and RRWUA wish to resolve this mat-
20 ter without further litigation and without affecting or im-
21 pairing any interests, claims, or defenses other than as
22 explicitly stated herein.

23 4. The resolution stipulated to herein is intended to
24 ensure that the operation of the Ruby River Reservoir
25 achieves and maintains compliance with the State's water
26 quality standards adopted under the authority of the Water
27

1 Quality Act (Title 75, Chapter 5, Montana Code Annotated
2 (MCA)).

3 C. Binding Effect

4 5. The provisions of this Consent Decree shall apply to
5 and be binding upon the DHES, DNRC, RRWUA, and their succes-
6 sors in interest or assigns.

7 D. General Provisions

8 6. The DHES is the state agency charged with the admin-
9 istration and enforcement of the Montana Water Quality Act,
10 Title 75, Chapter 5, MCA, (hereinafter the "Water Quality
11 Act"), including the authority to enforce water quality stan-
12 dards adopted pursuant to that Act.

13 7. The Defendant, DNRC, is the state agency charged
14 with the administration of water development projects, in-
15 cluding the construction of irrigation and flood projects,
16 pursuant to Title 85, Chapter 1, part 2, MCA. DNRC con-
17 structed and owns the Ruby River Reservoir located in Madison
18 County, Montana, and has acquired the right to store, con-
19 trol, and divert all unappropriated water of the Ruby River
20 in Madison County, Montana.

21 8. The Defendant, RRWUA, is a corporation organized and
22 existing under the laws of Montana and doing business in
23 Montana. RRWUA is the operator of the Ruby River Reservoir
24 in Madison County, Montana, pursuant to a contract entered
25 into between DNRC and RRWUA on March 3, 1937, and amendments
26 thereto.

27

1 9. Pursuant to its authority to enforce the State's
2 Water Quality Act, DHES commenced this action alleging that
3 the defendants caused pollution of the Ruby River by the
4 withdrawal of water from Ruby River Reservoir (hereinafter
5 "Reservoir") in violation of Section 75-5-605(1)(a) of the
6 Water Quality Act and surface water quality standards adopted
7 pursuant to that act. In particular, the withdrawal of water
8 from the Reservoir on September 1, 1994, caused violations of
9 the turbidity and oxygen standards in Ruby River and resulted
10 in a fish kill in the river below the dam.

11 10. The DHES alleges that as a result of the drainage
12 of the Reservoir on or before September 1, 1994, approximate-
13 ly 3,000 cubic yards of sediment remain deposited in the
14 first three miles of the Ruby River channel below the dam.
15 The continued presence of this sediment will likely cause
16 future violations of the turbidity and oxygen water quality
17 standards in Ruby River when those sediments are flushed
18 downstream in spring runoff.

19 11. The parties to this Consent Decree recognize the
20 need to formally address the violations alleged in the Com-
21 plaint and ensure that future operations of the Reservoir
22 will achieve and maintain compliance with the water quality
23 standards. The Defendants have been actively engaged in the
24 preparation of a "Reservoir Operations Plan", "Sediment Man-
25 agement Plan", and resource protection activities to address
26 this need. Accordingly, the parties agree that it is appro-
27

1 priate that the Defendants implement the compliance measures,
2 specifically the Reservoir Operations Plan, the Sediment
3 Management Plan, and resource protection activities, as fur-
4 ther described below.

5 E. Compliance Measures

6 12. Upon entry of this Consent Decree, DNRC and RRWUA
7 agree to submit to the DHES a "Reservoir Operations Plan"
8 that shall contain the following information:

9 (a) A completed mapping of the Reservoir to estab-
10 lish its present capacity to determine if there has been
11 a loss of acre-feet since its original construction in
12 1938;

13 (b) The establishment of a pool that must be at
14 least the minimum size necessary to prevent excessive
15 sediment discharge;

16 (c) Guidance for DNRC and RRWUA staff regarding the
17 decision-making process for the daily operation of the
18 dam and its operation in cases of an emergency; and

19 (d) Identify a pool level that will trigger closer
20 monitoring of the reservoir discharge rates.

21 13. Defendants DNRC and RRWUA further agree to immedi-
22 ately implement the Ruby River "Sediment Management Plan",
23 dated March 24, 1995, in accordance with DHES Authorization
24 No. Mt-40-95, regarding a short-term exemption from surface
25 water quality standards.

26 14. The parties agree that on receipt of the "Reservoir
27

1 Operations Plan" described above (hereinafter "plan"), the
2 DHES shall have fifteen (15) days to review the plan, and may
3 in consultation with the Defendants make changes to the plan
4 that are reasonably necessary to maintain the applicable
5 turbidity and oxygen water quality standards for Ruby River.
6 DNRC and RRWUA agree to implement the plan with the changes
7 that the Department approves as being reasonably necessary to
8 implement the plan.

9 15. In addition to the requirements specified in para-
10 graphs (12) through (14) above, DNRC and RRWUA agree to
11 perform additional resource protection/conservation activi-
12 ties to enhance the fishery and to maintain an adequate water
13 supply for water users as described in paragraphs (16)
14 through (19) below.

15 16. In order to enhance the fishery, the Defendants
16 agree to maintain water in the Reservoir significantly above
17 the minimum acre-feet necessary to ensure compliance with
18 water quality standards. The Defendants agree to maintain an
19 absolute minimum level of 2,600 acre-feet at an approximate
20 annual cost estimated to be Three Thousand Seventy-eight
21 Dollars (\$3,078) per year; the net present value of maintain-
22 ing a reservoir pool in excess of that required to prevent
23 excessive sediment discharge is estimated to be Three Hundred
24 and Sixty-seven Thousand Dollars (\$367,000). DHES agrees a
25 minimum level of 2,600 acre-feet is significantly above the
26 minimum acre-feet necessary to achieve compliance with water
27

1 quality standards.

2 17. In order to prevent dewatering of the Ruby River
3 and to benefit the fishery, the RRWUA agrees to maintain a
4 minimum release from the dam into Ruby River of 20 to 30
5 cubic feet per second during the months of November through
6 March of each year. The net present value of the in-stream
7 flows (approximately 6,000 to 9,000 acre-feet per year) over
8 a 50-year period is estimated to be \$958,369 to \$1,437,553.

9 18. In order to ensure that adequate flows are main-
10 tained in Ruby River for irrigation uses and for the support
11 of the fishery, Defendants agree to install four stream gag-
12 ing stations during the summer of 1995. The total cost for
13 installation, operation, and maintenance of these stations is
14 estimated to be \$83,400.

15 19. In order to ensure adequate delivery of water for
16 irrigation and to prevent dewatering, the RRWUA agrees to
17 actively work with the decreed water users to ensure that
18 measuring devices will be installed where necessary and crit-
19 ical to ensure delivery of water, to prevent dewatering with-
20 in the next five years, and to ensure the use of water com-
21 mensurate with decreed rights. It is anticipated that such
22 devices will be installed on various ditches at an average
23 cost of \$2,500 per ditch.

24 20. DNRC and RRWUA further agree to provide to DHES a
25 brief annual report summarizing implementation of the compli-
26 ance measures described in paragraphs (12) through (19)

27

1 above.

2 F. Release/Settlement

3 21. (a) In consideration for the actions taken by Defen-
4 dants under this Consent Decree, the DHES releases and cove-
5 nants not to bring further actions against Defendants for
6 violations of water quality alleged in the Complaint and
7 resulting from the dewatering of the Ruby River Reservoir in
8 September, 1994. DHES further covenants and agrees not to
9 pursue further legal action against the Defendants for water
10 quality violations not raised in the Complaint, but arising
11 from the dewatering of the Ruby River Reservoir in September,
12 1994. The releases and covenants provided by DHES in this
13 paragraph are conditioned upon proper implementation of this
14 Consent Decree, Judgment and Order by the Defendants. This
15 covenant not to sue does not limit the DHES' authority either
16 to enforce this Consent Decree or to enforce otherwise appli-
17 cable environmental laws and regulations.

18 (b) This Consent Decree constitutes a full settlement
19 and resolution of Defendants' noncompliance with the Water
20 Quality Act as alleged in the Department's Complaint dated
21 May 25, 1995.

22 G. Reservation of Rights

23 22. The DHES reserves its rights to bring an action
24 against any person, including the defendants, for civil or
25 criminal penalties or injunctive relief for any violation of
26 the Water Quality Act that is not specifically addressed by
27

1 the Complaint in this matter, by this Consent Decree, or
2 which does not arise from dewatering of the Ruby River Reser-
3 voir in September, 1994. The DHES also reserves all legal
4 and equitable remedies available to it to enforce the provi-
5 sions of this Consent Decree.

6 23. The DHES does not, by its consent to the entry of
7 this Consent Decree, warrant or aver in any manner that the
8 Defendants' complete compliance with this Consent Decree will
9 result in compliance with applicable provisions of the Mon-
10 tana Water Quality Act or rules implementing that Act. Not-
11 withstanding the DHES' review and approval of any plans for-
12 mulated pursuant to this Consent Decree, the Defendants'
13 shall remain solely responsible for compliance with the terms
14 of the Act and this Consent Decree.

15 24. The Defendants reserve their rights which they may
16 have to oppose and defend against any claims brought by the
17 DHES that are not averred in the Complaint, and to assert any
18 claims they may have against any person.

19 H. Effective Date

20 25. This Consent Decree is effective upon the date of
21 execution by this Court.

22 I. Termination

23 26. The Defendants may petition the Court, with service
24 to the DHES, for termination of this Consent Decree when
25 Defendants have completed all obligations specified under the
26 Compliance Terms of this Consent Decree.

27

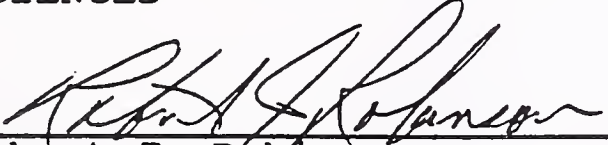
1 J. Authorization


2 27. The undersigned representatives of the Defendants
3 and the DHES certify that they are authorized by their re-
4 spective parties to enter into this Consent Decree and to
5 execute and legally bind that party to the terms and condi-
6 tions of this Consent Decree.

7 28. The parties hereby agree to the entry of this Con-
8 sent Decree, Judgment and Order as more fully appears from
9 their signatures written below.

10 MONTANA DEPARTMENT OF
11 HEALTH AND ENVIRONMENTAL
12 SCIENCES


MONTANA DEPARTMENT OF
NATURAL RESOURCES AND
CONSERVATION

13 BY: 
14 Robert J. Robinson
Director

BY: 
Mark Simonich
Director

15 MONTANA DEPARTMENT OF
16 HEALTH AND ENVIRONMENTAL
SCIENCES

RUBY RIVER WATER
USERS' ASSOCIATION

17 BY:  5/18/95
18 Claudia L. Massman
19 Assistant Attorney General

BY:  Pres.

20 ORDER AND JUDGMENT

21 THIS MATTER having come before the Court upon the par-
22 ties' request for entry of this Consent Decree, Judgment, and
23 Order, and the Court having fully reviewed the matter, it is
24 hereby

25 FOUND that the terms and provisions of this Consent
26 Decree in their entirety represent a fair, reasonable, and
27

1 equitable settlement of all matters and it is therefore
2 ORDERED that the foregoing terms and conditions of the
3 Consent Decree are adopted by the Court and made an Order and
4 Judgment of this Court.

5 DATED this 30 day of May, 1995.

6 DOROTHY McCARTER
7 District Judge

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RUBY RIVER RESERVOIR

OPERATING GUIDELINES

The Ruby River Reservoir is owned by the Department of Natural Resources and Conservation (DNRC) and operated by the Ruby River Water Users Association (RRWUA). The reservoir is to be operated within the guidelines outlined below.

Regulate Outflow

- Goals:**
- Satisfy contracts.¹
 - Minimize erosion and downstream flooding.
 - Prevent dewatering of the Ruby River downstream from the reservoir.

- Guidelines:**
1. The maximum sustainable outflow is 18,000 miner's inches (450 cfs). This rate can be exceeded up to a maximum of 24,000 miner's inches (600 cfs) for short periods of time.
 2. A minimum flow of 800 to 1,200 miner's inches (20-30 cfs) must be maintained at the dam outlet.
 3. If there is a demand from decreed water users, the amount of the inflow to the dam shall be allowed to flow out of the reservoir and past the diversion dam.
 4. The RRWUA will work with contract holders, decreed water users and the DNRC to implement the Water Delivery and Dewatering Prevention Plan for the Ruby River.
 5. The RRWUA shall notify the DNRC when flows drop to key points identified in the Water Delivery and Dewatering Prevention Plan. Staff gage readings from the following

¹ Peak irrigation demand is typically 20,000 to 25,000 miner's inches (500 to 625 cfs). In mid-July irrigation demands decrease to 12,000 to 15,000 miner's inches (300 to 375 cfs).

bridges will also be reported to the DNRC as noted in the plan: Coy Brown, Alder, Laurin, Silver Springs, Harrington and Phipps.

Regulate Reservoir Elevations

- Goals:**
- Provide stored water to fulfill contracts.
 - Prevent sediment from washing out of the reservoir and adversely affecting water quality downstream by maintaining a minimum pool in the reservoir.

- Guidelines:**
1. By April 1 of each year, the RRWUA and the DNRC shall meet to evaluate reservoir storage, snowpack, streamflow, streamflow forecast, soil moisture and the weather forecast.

If the reservoir elevation is higher than average² and indications are that a wet, high runoff spring could exist, the RRWUA and the DNRC will consider increasing the outflow to provide some capacity for flood control and also to postpone the spill so that it coincides with peak irrigation demand.

If the reservoir elevation is lower than average and conditions indicate that a dry, low runoff spring³ could exist, the RRWUA and DNRC will evaluate alternatives for allocating water to ensure that water is available throughout the irrigation season.

2. The RRWUA will notify the DNRC when the free-flow or natural flow period has ended and the RRWUA begins to satisfy contracts for stored water.
3. If the amount of water in the reservoir drops

² 5,384 feet.

³ For example, dry conditions existed during the years 1988, 1992 and 1994. Conditions during these years can be used for comparison purposes.

to 7,500 acre-feet, representatives of the RRWUA, the DNRC and the Department of Fish, Wildlife and Parks will meet to discuss future operation of the reservoir and to determine what accommodations need to be made in order to maintain a minimum pool. The DNRC will establish a benchmark at the corresponding elevation.

4. The reservoir storage may not be drawn down below 2,600 acre-feet, which is the absolute minimum pool. The DNRC will establish a benchmark at the corresponding elevation.
5. The RRWUA will report to the DNRC every two weeks on the current reservoir elevation.

Emergency Response

- Goals:**
- Provide maximum early warning in the event of a failure of the Ruby Dam. Minimize loss of life or property.

- Guidelines:**
1. The RRWUA will follow the Emergency Plan for the Ruby Reservoir.

Maintenance

- Goals:**
- Maintain the dam in good condition so that it will continue to fulfill its function of providing a reliable source of irrigation water.
 - Maintain the dam in good condition so as to minimize the risk to life or property downstream of the dam.

- Guidelines:**
1. The RRWUA will operate and maintain the reservoir in accordance with the Ruby River Reservoir Manual for Operation and Maintenance.

APPENDIX B
RATING CURVES AND TABLES

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE

RUBY RESERVOIR

Slope pins installed October 13, 2000.

The 0+00 pin is located 8 feet above the eroded bank near the old slope line.

The alignment is slightly west of the old line and a path was cleared through the rocks.

A level was used to the 3+21 point and a GPS was used for the remaining points.

Storage values based on new topographic maps completed in 1994.

| DISTANCE feet | ELEVATION feet | STORAGE acre-feet | | DISTANCE feet | ELEVATION feet | STORAGE acre-feet |
|------------------|-------------------|----------------------|--|------------------|-------------------|----------------------|
| 0 | 5400.37 | 45,552 | | 36 | 5392.05 | 36,683 |
| 1 | 5400.15 | 45,292 | | 37 | 5391.93 | 36,565 |
| 2 | 5399.93 | 45,038 | | 38 | 5391.82 | 36,459 |
| 3 | 5399.71 | 44,798 | | 39 | 5391.71 | 36,353 |
| 4 | 5399.49 | 44,558 | | 40 | 5391.60 | 36,247 |
| 5 | 5399.27 | 44,318 | | 41 | 5391.48 | 36,131 |
| 6 | 5399.05 | 44,078 | | 42 | 5391.36 | 36,015 |
| 7 | 5398.83 | 43,839 | | 43 | 5391.24 | 35,899 |
| 8 | 5398.64 | 43,631 | | 44 | 5391.11 | 35,774 |
| 9 | 5397.83 | 42,748 | | 45 | 5390.99 | 35,659 |
| 10 | 5397.03 | 41,875 | | 46 | 5390.87 | 35,542 |
| 11 | 5396.23 | 41,003 | | 47 | 5390.75 | 35,426 |
| 12 | 5395.43 | 40,131 | | 48 | 5390.63 | 35,311 |
| 13 | 5395.02 | 39,683 | | 0+50 CAP | 5390.58 | 35,262 |
| 14 | 5394.87 | 39,530 | | 49 | 5390.51 | 35,195 |
| 15 | 5394.73 | 39,389 | | 50 | 5390.40 | 35,089 |
| 16 | 5394.58 | 39,237 | | 51 | 5390.32 | 35,011 |
| 17 | 5394.43 | 39,086 | | 52 | 5390.25 | 34,944 |
| 18 | 5394.29 | 38,945 | | 53 | 5390.17 | 34,867 |
| 19 | 5394.14 | 38,793 | | 54 | 5390.09 | 34,789 |
| 20 | 5394.01 | 38,662 | | 55 | 5390.01 | 34,712 |
| 21 | 5393.88 | 38,531 | | 56 | 5389.93 | 34,638 |
| 22 | 5393.75 | 38,399 | | 57 | 5389.85 | 34,565 |
| 23 | 5393.62 | 38,268 | | 58 | 5389.78 | 34,501 |
| 24 | 5393.49 | 38,137 | | 59 | 5389.70 | 34,427 |
| 25 | 5393.36 | 38,006 | | 60 | 5389.63 | 34,363 |
| 26 | 5393.23 | 37,874 | | 61 | 5389.52 | 34,262 |
| 27 | 5393.09 | 37,733 | | 62 | 5389.41 | 34,162 |
| 28 | 5392.96 | 37,602 | | 63 | 5389.30 | 34,061 |
| 29 | 5392.83 | 37,471 | | 64 | 5389.20 | 33,969 |
| 30 | 5392.71 | 37,349 | | 65 | 5389.09 | 33,869 |
| 31 | 5392.60 | 37,238 | | 66 | 5388.98 | 33,767 |
| 32 | 5392.49 | 37,127 | | 67 | 5388.88 | 33,676 |
| 33 | 5392.38 | 37,016 | | 68 | 5388.77 | 33,575 |
| 34 | 5392.27 | 36,905 | | 69 | 5388.66 | 33,474 |
| 35 | 5392.16 | 36,794 | | 70 | 5388.56 | 33,382 |
| | | | | | | |
| DISTANCE | ELEVATION | STORAGE | | DISTANCE | ELEVATION | STORAGE |

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)

RUBY RESERVOIR

| DISTANCE feet | ELEVATION feet | STORAGE acre-feet | | DISTANCE feet | ELEVATION feet | STORAGE acre-feet |
|------------------|-------------------|----------------------|--|------------------|-------------------|----------------------|
| 71 | 5388.50 | 33,327 | | 114 | 5384.18 | 29,415 |
| 72 | 5388.44 | 33,272 | | 115 | 5384.01 | 29,270 |
| 73 | 5388.38 | 33,217 | | 116 | 5383.84 | 29,124 |
| 74 | 5388.32 | 33,162 | | 117 | 5383.68 | 28,987 |
| 75 | 5388.26 | 33,107 | | 118 | 5383.51 | 28,841 |
| 76 | 5388.20 | 33,052 | | 119 | 5383.34 | 28,696 |
| 77 | 5388.14 | 32,997 | | 120 | 5383.06 | 28,456 |
| 78 | 5388.07 | 32,933 | | 121 | 5382.87 | 28,293 |
| 79 | 5388.01 | 32,878 | | 122 | 5382.67 | 28,122 |
| 80 | 5387.96 | 32,832 | | 123 | 5382.47 | 27,950 |
| 81 | 5387.89 | 32,768 | | 124 | 5382.28 | 27,788 |
| 82 | 5387.83 | 32,713 | | 125 | 5382.08 | 27,616 |
| 83 | 5387.77 | 32,658 | | 126 | 5381.88 | 27,445 |
| 84 | 5387.70 | 32,593 | | 127 | 5381.68 | 27,274 |
| 85 | 5387.64 | 32,538 | | 128 | 5381.49 | 27,111 |
| 86 | 5387.57 | 32,474 | | 129 | 5381.29 | 26,940 |
| 87 | 5387.51 | 32,419 | | 130 | 5381.10 | 26,777 |
| 88 | 5387.45 | 32,364 | | 131 | 5380.88 | 26,588 |
| 89 | 5387.38 | 32,300 | | 132 | 5380.66 | 26,400 |
| 90 | 5387.32 | 32,245 | | 133 | 5380.44 | 26,211 |
| 91 | 5387.21 | 32,144 | | 134 | 5380.22 | 26,023 |
| 92 | 5387.10 | 32,043 | | 135 | 5380.00 | 25,835 |
| 93 | 5386.99 | 31,942 | | 136 | 5379.78 | 25,664 |
| 94 | 5386.88 | 31,842 | | 137 | 5379.56 | 25,494 |
| 95 | 5386.77 | 31,741 | | 138 | 5379.34 | 25,324 |
| 96 | 5386.66 | 31,640 | | 139 | 5379.12 | 25,154 |
| 97 | 5386.54 | 31,530 | | 140 | 5378.88 | 24,969 |
| 98 | 5386.43 | 31,429 | | 141 | 5378.70 | 24,830 |
| 99 | 5386.32 | 31,328 | | 142 | 5378.48 | 24,660 |
| 100 | 5386.21 | 31,227 | | 143 | 5378.16 | 24,412 |
| 1+00 CAP | 5386.20 | 31,218 | | 144 | 5377.84 | 24,165 |
| 101 | 5386.08 | 31,108 | | 145 | 5377.52 | 23,918 |
| 102 | 5385.96 | 30,998 | | 146 | 5377.20 | 23,670 |
| 103 | 5385.83 | 30,879 | | 147 | 5376.87 | 23,415 |
| 104 | 5385.71 | 30,769 | | 148 | 5376.46 | 23,098 |
| 105 | 5385.58 | 30,649 | | 149 | 5376.23 | 22,920 |
| 106 | 5385.46 | 30,539 | | 150 | 5376.10 | 22,820 |
| 107 | 5385.33 | 30,420 | | 1+50 CAP | 5376.10 | 22,820 |
| 108 | 5385.21 | 30,310 | | 151 | 5375.86 | 22,634 |
| 109 | 5385.08 | 30,191 | | 152 | 5375.61 | 22,441 |
| 110 | 5384.85 | 29,989 | | 153 | 5375.37 | 22,256 |
| 111 | 5384.68 | 29,843 | | 154 | 5375.12 | 22,062 |
| 112 | 5384.51 | 29,698 | | 155 | 5374.88 | 21,889 |
| 113 | 5384.35 | 29,561 | | | | |
| DISTANCE | ELEVATION | STORAGE | | DISTANCE | ELEVATION | STORAGE |

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)

RUBY RESERVOIR

| DISTANCE feet | ELEVATION feet | STORAGE acre-feet | | DISTANCE feet | ELEVATION feet | STORAGE acre-feet |
|------------------|-------------------|----------------------|--|------------------|-------------------|----------------------|
| 156 | 5374.63 | 21,722 | | 203 | 5365.61 | 16,045 |
| 157 | 5374.39 | 21,561 | | 204 | 5365.46 | 15,951 |
| 158 | 5374.14 | 21,394 | | 205 | 5365.31 | 15,869 |
| 159 | 5373.90 | 21,234 | | 206 | 5365.17 | 15,786 |
| 160 | 5373.73 | 21,121 | | 207 | 5365.02 | 15,698 |
| 161 | 5373.49 | 20,959 | | 208 | 5364.87 | 15,618 |
| 162 | 5373.26 | 20,812 | | 209 | 5364.72 | 15,540 |
| 163 | 5373.03 | 20,652 | | 210 | 5364.57 | 15,461 |
| 164 | 5372.80 | 20,498 | | 211 | 5364.40 | 15,372 |
| 165 | 5372.56 | 20,337 | | 212 | 5364.24 | 15,288 |
| 166 | 5372.33 | 20,183 | | 213 | 5364.07 | 15,199 |
| 167 | 5372.10 | 20,029 | | 214 | 5363.91 | 15,115 |
| 168 | 5371.86 | 19,869 | | 215 | 5363.74 | 15,026 |
| 169 | 5371.63 | 19,715 | | 216 | 5363.58 | 14,942 |
| 170 | 5371.39 | 19,554 | | 217 | 5363.41 | 14,853 |
| 171 | 5371.19 | 19,421 | | 218 | 5363.25 | 14,770 |
| 172 | 5371.00 | 19,294 | | 219 | 5363.08 | 14,680 |
| 173 | 5370.81 | 19,166 | | 220 | 5362.93 | 14,602 |
| 174 | 5370.62 | 19,039 | | 221 | 5362.77 | 14,518 |
| 175 | 5370.43 | 18,912 | | 222 | 5362.61 | 14,434 |
| 180 | 5369.48 | 18,314 | | 223 | 5362.45 | 14,350 |
| 181 | 5369.30 | 18,213 | | 224 | 5362.29 | 14,267 |
| 182 | 5369.13 | 18,113 | | 225 | 5362.13 | 14,183 |
| 183 | 5368.95 | 18,008 | | 226 | 5361.97 | 14,099 |
| 184 | 5368.77 | 17,902 | | 227 | 5361.80 | 14,010 |
| 185 | 5368.60 | 17,802 | | 228 | 5361.64 | 13,926 |
| 186 | 5368.42 | 17,696 | | 229 | 5361.48 | 13,842 |
| 187 | 5368.24 | 17,590 | | 230 | 5361.32 | 13,758 |
| 188 | 5368.06 | 17,485 | | 231 | 5361.18 | 13,685 |
| 189 | 5367.89 | 17,385 | | 232 | 5361.04 | 13,612 |
| 190 | 5367.71 | 17,279 | | 233 | 5360.90 | 13,538 |
| 191 | 5367.55 | 17,185 | | 234 | 5360.76 | 13,465 |
| 192 | 5367.38 | 17,085 | | 235 | 5360.61 | 13,386 |
| 193 | 5367.21 | 16,985 | | 236 | 5360.47 | 13,313 |
| 194 | 5367.05 | 16,891 | | 237 | 5360.33 | 13,239 |
| 195 | 5366.88 | 16,791 | | 238 | 5360.19 | 13,166 |
| 196 | 5366.72 | 16,697 | | 239 | 5360.05 | 13,093 |
| 197 | 5366.55 | 16,597 | | 240 | 5359.92 | 13,030 |
| 198 | 5366.38 | 16,497 | | 241 | 5359.77 | 12,960 |
| 199 | 5366.22 | 16,403 | | 242 | 5359.63 | 12,896 |
| 200 | 5366.06 | 16,309 | | 243 | 5359.48 | 12,827 |
| 2+00 CAP | 5366.03 | 16,292 | | 244 | 5359.33 | 12,757 |
| 201 | 5365.91 | 16,221 | | 245 | 5359.19 | 12,693 |
| 202 | 5365.76 | 16,133 | | | | |
| DISTANCE | ELEVATION | STORAGE | | DISTANCE | ELEVATION | STORAGE |

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)

RUBY RESERVOIR

| DISTANCE feet | ELEVATION feet | STORAGE acre-feet | | DISTANCE feet | ELEVATION feet | STORAGE acre-feet |
|------------------|-------------------|----------------------|--|------------------|-------------------|----------------------|
| 246 | 5359.04 | 12,626 | | 290 | 5351.10 | 9,160 |
| 247 | 5358.90 | 12,559 | | 291 | 5351.04 | 9,135 |
| 248 | 5358.75 | 12,490 | | 292 | 5350.97 | 9,110 |
| 249 | 5358.60 | 12,420 | | 293 | 5350.91 | 9,082 |
| 250 | 5358.44 | 12,346 | | 294 | 5350.84 | 9,053 |
| 2+50 CAP | 5358.40 | 12,328 | | 295 | 5350.78 | 9,028 |
| 251 | 5358.27 | 12,268 | | 296 | 5350.72 | 9,004 |
| 252 | 5358.10 | 12,190 | | 297 | 5350.65 | 8,975 |
| 253 | 5357.93 | 12,111 | | 298 | 5350.59 | 8,946 |
| 254 | 5357.77 | 12,037 | | 299 | 5350.52 | 8,922 |
| 256 | 5357.43 | 11,880 | | 3+00 CAP | 5350.47 | 8,901 |
| 257 | 5357.26 | 11,802 | | 300 | 5350.47 | 8,901 |
| 258 | 5357.10 | 11,728 | | 301 | 5350.41 | 8,877 |
| 259 | 5356.93 | 11,649 | | 302 | 5350.34 | 8,848 |
| 260 | 5356.78 | 11,580 | | 303 | 5350.28 | 8,823 |
| 261 | 5356.60 | 11,497 | | 304 | 5350.22 | 8,799 |
| 262 | 5356.42 | 11,414 | | 305 | 5350.15 | 8,770 |
| 263 | 5356.24 | 11,331 | | 306 | 5350.09 | 8,745 |
| 264 | 5356.06 | 11,248 | | 307 | 5349.97 | 8,698 |
| 265 | 5355.88 | 11,165 | | 308 | 5349.76 | 8,621 |
| 266 | 5355.70 | 11,082 | | 309 | 5349.54 | 8,540 |
| 267 | 5355.52 | 10,999 | | 310 | 5349.32 | 8,459 |
| 268 | 5355.34 | 10,915 | | 311 | 5349.10 | 8,379 |
| 269 | 5355.16 | 10,832 | | 312 | 5348.88 | 8,298 |
| 270 | 5354.98 | 10,750 | | 313 | 5348.82 | 8,276 |
| 271 | 5354.81 | 10,681 | | 314 | 5348.64 | 8,210 |
| 272 | 5354.64 | 10,611 | | 315 | 5348.46 | 8,144 |
| 273 | 5354.46 | 10,537 | | 316 | 5348.29 | 8,082 |
| 274 | 5354.29 | 10,467 | | 317 | 5348.09 | 8,008 |
| 275 | 5354.12 | 10,390 | | 318 | 5347.75 | 7,884 |
| 276 | 5353.95 | 10,328 | | 319 | 5347.42 | 7,763 |
| 277 | 5353.77 | 10,254 | | 320 | 5347.08 | 7,638 |
| 278 | 5353.60 | 10,184 | | 3+21 CAP | 5346.70 | 7,500 |
| 279 | 5353.43 | 10,115 | | 321 | 5346.69 | 7,495 |
| 280 | 5353.27 | 10,049 | | 322 | 5346.33 | 7,363 |
| 281 | 5353.18 | 10,012 | | 323 | 5345.96 | 7,227 |
| 282 | 5352.91 | 9,902 | | 324 | 5345.59 | 7,092 |
| 283 | 5352.65 | 9,795 | | 325 | 5345.10 | 6,912 |
| 284 | 5352.39 | 9,688 | | 326 | 5344.59 | 6,741 |
| 285 | 5352.13 | 9,582 | | 327 | 5343.54 | 6,698 |
| 286 | 5351.86 | 9,471 | | 328 | 5343.03 | 6,231 |
| 287 | 5351.37 | 9,270 | | 329 | 5342.53 | 6,068 |
| 288 | 5351.26 | 9,225 | | | | |
| 289 | 5351.16 | 9,184 | | | | |
| DIST | ELEV | STOR | | DIST | ELEV | STOR |

TABLE 2. SLOPE-ELEVATION-STORAGE (ALTERNATE) TABLE

RUBY RESERVOIR

This table is for use when the reservoir is at or below 7,500 AF (Elevation 5346.70).

Slope pins installed September 20, 2000.

The 0+00 pin is located 48.5 ft on a magnetic heading of 240 degrees from a fiberglass fence post driven in at the base of the rock outcrop that forms the flat area in front of the spillway.

The slope pin alignment is 240 degrees magnetic

Storage values based on new topographic maps completed in 1994.

| DISTANCE feet | ELEVATION feet | STORAGE acre-feet | | DISTANCE feet | ELEVATION feet | STORAGE acre-feet |
|------------------|-------------------|----------------------|--|------------------|-------------------|----------------------|
| A0+00 CAP | 5346.70 | 7,499 | | 35 | 5343.16 | 6,274 |
| 1 | 5346.62 | 7,469 | | 36 | 5343.04 | 6,235 |
| 2 | 5346.54 | 7,440 | | 37 | 5342.91 | 6,192 |
| 3 | 5346.47 | 7,414 | | 38 | 5342.79 | 6,153 |
| 4 | 5346.39 | 7,385 | | 39 | 5342.66 | 6,110 |
| 5 | 5346.31 | 7,356 | | 40 | 5342.55 | 6,074 |
| 6 | 5346.23 | 7,326 | | 41 | 5342.44 | 6,038 |
| 7 | 5346.15 | 7,297 | | 42 | 5342.33 | 6,002 |
| 8 | 5346.08 | 7,271 | | 43 | 5342.22 | 5,966 |
| 9 | 5346.00 | 7,242 | | 44 | 5342.11 | 5,931 |
| 10 | 5345.93 | 7,216 | | 45 | 5342.00 | 5,895 |
| 11 | 5345.84 | 7,183 | | 46 | 5341.89 | 5,859 |
| 12 | 5345.75 | 7,150 | | 47 | 5341.78 | 5,823 |
| 13 | 5345.66 | 7,118 | | 48 | 5341.67 | 5,787 |
| 14 | 5345.57 | 7,085 | | 49 | 5341.56 | 5,751 |
| 15 | 5345.49 | 7,055 | | A0+50 CAP | 5341.45 | 5,715 |
| 16 | 5345.40 | 7,022 | | 51 | 5341.36 | 5,685 |
| 17 | 5345.31 | 6,989 | | 52 | 5341.27 | 5,656 |
| 18 | 5345.22 | 6,956 | | 53 | 5341.17 | 5,623 |
| 19 | 5345.13 | 6,923 | | 54 | 5341.08 | 5,594 |
| 20 | 5345.01 | 6,879 | | 55 | 5340.99 | 5,564 |
| 21 | 5344.89 | 6,840 | | 56 | 5340.90 | 5,535 |
| 22 | 5344.76 | 6,797 | | 57 | 5340.80 | 5,502 |
| 23 | 5344.64 | 6,758 | | 58 | 5340.71 | 5,473 |
| 24 | 5344.51 | 6,715 | | 59 | 5340.62 | 5,443 |
| 25 | 5344.39 | 6,676 | | 60 | 5340.56 | 5,424 |
| 26 | 5344.26 | 6,634 | | 61 | 5340.48 | 5,398 |
| 27 | 5344.14 | 6,594 | | 62 | 5340.39 | 5,368 |
| 28 | 5344.01 | 6,552 | | 63 | 5340.31 | 5,342 |
| 29 | 5343.89 | 6,513 | | 64 | 5340.22 | 5,312 |
| 30 | 5343.79 | 6,480 | | 65 | 5340.14 | 5,286 |
| 31 | 5343.66 | 6,437 | | 66 | 5340.05 | 5,257 |
| 32 | 5343.54 | 6,398 | | 67 | 5339.97 | 5,232 |
| 33 | 5343.41 | 6,356 | | 68 | 5339.89 | 5,209 |
| 34 | 5343.29 | 6,316 | | 69 | 5339.80 | 5,183 |
| DISTANCE | ELEVATION | STORAGE | | DISTANCE | ELEVATION | STORAGE |

TABLE 2. SLOPE-ELEVATION-STORAGE (ALTERNATE) TABLE

RUBY RESERVOIR

| DISTANCE feet | ELEVATION feet | STORAGE acre-feet | | DISTANCE feet | ELEVATION feet | STORAGE acre-feet |
|------------------|-------------------|----------------------|--|------------------|-------------------|----------------------|
| 70 | 5339.69 | 5,151 | | 113 | 5336.51 | 4,230 |
| 71 | 5339.61 | 5,128 | | 114 | 5336.40 | 4,198 |
| 72 | 5339.52 | 5,102 | | 115 | 5336.28 | 4,163 |
| 73 | 5339.44 | 5,078 | | 116 | 5336.17 | 4,131 |
| 74 | 5339.36 | 5,055 | | 117 | 5336.06 | 4,100 |
| 75 | 5339.27 | 5,029 | | 118 | 5335.95 | 4,068 |
| 76 | 5339.19 | 5,006 | | 119 | 5335.83 | 4,033 |
| 77 | 5339.11 | 4,983 | | 120 | 5335.72 | 4,001 |
| 78 | 5339.02 | 4,957 | | 121 | 5335.64 | 3,978 |
| 79 | 5338.94 | 4,934 | | 122 | 5335.55 | 3,952 |
| 80 | 5338.87 | 4,913 | | 123 | 5335.47 | 3,929 |
| 81 | 5338.81 | 4,896 | | 124 | 5335.39 | 3,905 |
| 82 | 5338.75 | 4,879 | | 125 | 5335.31 | 3,882 |
| 83 | 5338.69 | 4,861 | | 126 | 5335.22 | 3,856 |
| 84 | 5338.63 | 4,844 | | 127 | 5335.14 | 3,833 |
| 85 | 5338.57 | 4,826 | | 128 | 5335.06 | 3,810 |
| 86 | 5338.51 | 4,809 | | 129 | 5334.97 | 3,785 |
| 87 | 5338.45 | 4,792 | | 130 | 5334.89 | 3,765 |
| 88 | 5338.39 | 4,774 | | 131 | 5334.81 | 3,745 |
| 89 | 5338.33 | 4,757 | | 132 | 5334.74 | 3,727 |
| 90 | 5338.28 | 4,742 | | 133 | 5334.66 | 3,707 |
| 91 | 5338.23 | 4,728 | | 134 | 5334.59 | 3,689 |
| 92 | 5338.18 | 4,713 | | 135 | 5334.51 | 3,669 |
| 93 | 5338.14 | 4,702 | | 136 | 5334.44 | 3,652 |
| 94 | 5338.09 | 4,687 | | 137 | 5334.36 | 3,632 |
| 95 | 5338.04 | 4,673 | | 138 | 5334.29 | 3,614 |
| 96 | 5337.99 | 4,658 | | 139 | 5334.21 | 3,594 |
| 97 | 5337.94 | 4,644 | | 140 | 5334.14 | 3,576 |
| 98 | 5337.89 | 4,629 | | 141 | 5334.06 | 3,556 |
| 99 | 5337.85 | 4,618 | | 142 | 5333.98 | 3,536 |
| A1+00 CAP | 5337.80 | 4,603 | | 143 | 5333.91 | 3,518 |
| 101 | 5337.70 | 4,574 | | 144 | 5333.83 | 3,498 |
| 102 | 5337.61 | 4,548 | | 145 | 5333.75 | 3,478 |
| 103 | 5337.51 | 4,519 | | 146 | 5333.67 | 3,458 |
| 104 | 5337.42 | 4,493 | | 147 | 5333.59 | 3,438 |
| 105 | 5337.32 | 4,464 | | 148 | 5333.52 | 3,420 |
| 106 | 5337.23 | 4,438 | | 149 | 5333.44 | 3,400 |
| 107 | 5337.13 | 4,409 | | A1+50 CAP | 5333.37 | 3,382 |
| 108 | 5337.04 | 4,383 | | 151 | 5333.27 | 3,357 |
| 109 | 5336.94 | 4,354 | | 152 | 5333.17 | 3,332 |
| 110 | 5336.85 | 4,328 | | 153 | 5333.08 | 3,309 |
| 111 | 5336.74 | 4,296 | | 154 | 5332.93 | 3,272 |
| 112 | 5336.62 | 4,262 | | 155 | 5332.82 | 3,244 |
| DISTANCE | ELEVATION | STORAGE | | DISTANCE | ELEVATION | STORAGE |

TABLE 3. TOTAL STORAGE IN ACRE-FEET**RUBY RESERVOIR**

| Elevation | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 5301 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 5302 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5303 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 5304 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 5305 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 5306 | 13 | 14 | 15 | 16 | 17 | 18 | 20 | 21 | 22 | 23 |
| 5307 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
| 5308 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| 5309 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 |
| 5310 | 56 | 60 | 65 | 70 | 74 | 79 | 83 | 88 | 93 | 97 |
| 5311 | 102 | 107 | 111 | 116 | 120 | 125 | 130 | 134 | 139 | 143 |
| 5312 | 148 | 153 | 157 | 162 | 166 | 171 | 176 | 180 | 185 | 189 |
| 5313 | 194 | 199 | 203 | 208 | 212 | 217 | 222 | 226 | 231 | 235 |
| 5314 | 240 | 245 | 249 | 254 | 258 | 263 | 268 | 272 | 277 | 281 |
| 5315 | 286 | 295 | 305 | 315 | 325 | 335 | 345 | 355 | 364 | 674 |
| 5316 | 384 | 394 | 404 | 414 | 424 | 433 | 443 | 453 | 463 | 473 |
| 5317 | 483 | 493 | 502 | 512 | 522 | 532 | 542 | 552 | 562 | 571 |
| 5318 | 581 | 591 | 601 | 611 | 621 | 631 | 641 | 650 | 660 | 670 |
| 5319 | 680 | 690 | 700 | 710 | 719 | 729 | 739 | 749 | 759 | 769 |
| 5320 | 779 | 793 | 808 | 823 | 838 | 853 | 868 | 883 | 897 | 912 |
| 5321 | 927 | 942 | 957 | 972 | 987 | 1,001 | 1,016 | 1,031 | 1,046 | 1,061 |
| 5322 | 1,076 | 1,091 | 1,105 | 1,120 | 1,135 | 1,150 | 1,165 | 1,180 | 1,195 | 1,209 |
| 5323 | 1,224 | 1,239 | 1,254 | 1,269 | 1,284 | 1,299 | 1,314 | 1,328 | 1,343 | 1,358 |
| 5324 | 1,373 | 1,388 | 1,403 | 1,418 | 1,432 | 1,447 | 1,462 | 1,477 | 1,492 | 1,507 |
| 5325 | 1,522 | 1,542 | 1,562 | 1,582 | 1,603 | 1,623 | 1,643 | 1,663 | 1,684 | 1,704 |
| 5326 | 1,724 | 1,744 | 1,765 | 1,785 | 1,805 | 1,825 | 1,846 | 1,866 | 1,886 | 1,906 |
| 5327 | 1,927 | 1,947 | 1,967 | 1,988 | 2,008 | 2,028 | 2,048 | 2,069 | 2,089 | 2,109 |
| 5328 | 2,129 | 2,150 | 2,170 | 2,190 | 2,210 | 2,231 | 2,251 | 2,271 | 2,291 | 2,312 |
| 5329 | 2,332 | 2,352 | 2,372 | 2,393 | 2,413 | 2,433 | 2,454 | 2,474 | 2,494 | 2,514 |
| 5330 | 2,535 | 2,560 | 2,585 | 2,610 | 2,635 | 2,660 | 2,686 | 2,711 | 2,736 | 2,761 |
| 5331 | 2,786 | 2,811 | 2,836 | 2,862 | 2,887 | 2,912 | 2,937 | 2,962 | 2,987 | 3,013 |
| 5332 | 3,038 | 3,063 | 3,088 | 3,113 | 3,138 | 3,164 | 3,189 | 3,214 | 3,239 | 3,264 |
| 5333 | 3,289 | 3,315 | 3,340 | 3,365 | 3,390 | 3,415 | 3,440 | 3,465 | 3,491 | 3,516 |
| 5334 | 3,541 | 3,566 | 3,591 | 3,616 | 3,642 | 3,667 | 3,692 | 3,717 | 3,742 | 3,767 |
| 5335 | 3,793 | 3,822 | 3,850 | 3,879 | 3,908 | 3,937 | 3,966 | 3,995 | 4,024 | 4,053 |
| 5336 | 4,082 | 4,111 | 4,140 | 4,169 | 4,198 | 4,227 | 4,256 | 4,285 | 4,314 | 4,343 |
| 5337 | 4,372 | 4,401 | 4,430 | 4,459 | 4,488 | 4,517 | 4,546 | 4,574 | 4,603 | 4,632 |
| 5338 | 4,661 | 4,690 | 4,719 | 4,748 | 4,777 | 4,806 | 4,835 | 4,864 | 4,893 | 4,922 |
| 5339 | 4,951 | 4,980 | 5,009 | 5,038 | 5,067 | 5,096 | 5,125 | 5,154 | 5,183 | 5,212 |
| 5340 | 5,241 | 5,273 | 5,306 | 5,339 | 5,371 | 5,404 | 5,437 | 5,469 | 5,502 | 5,535 |

TABLE 3. TOTAL STORAGE IN ACRE-FEET (continued)

RUBY RESERVOIR

| Elevation | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 5341 | 5,568 | 5,600 | 5,633 | 5,666 | 5,698 | 5,731 | 5,764 | 5,796 | 5,829 | 5,862 |
| 5342 | 5,895 | 5,927 | 5,960 | 5,993 | 6,025 | 6,058 | 6,091 | 6,123 | 6,156 | 6,189 |
| 5343 | 6,222 | 6,254 | 6,287 | 6,320 | 6,352 | 6,385 | 6,418 | 6,450 | 6,483 | 6,516 |
| 5344 | 6,549 | 6,581 | 6,614 | 6,647 | 6,679 | 6,712 | 6,745 | 6,777 | 6,810 | 6,843 |
| 5345 | 6,876 | 6,912 | 6,949 | 6,986 | 7,022 | 7,059 | 7,096 | 7,132 | 7,169 | 7,205 |
| 5346 | 7,242 | 7,279 | 7,315 | 7,352 | 7,389 | 7,425 | 7,462 | 7,499 | 7,535 | 7,572 |
| 5347 | 7,609 | 7,645 | 7,682 | 7,719 | 7,755 | 7,792 | 7,829 | 7,865 | 7,902 | 7,939 |
| 5348 | 7,975 | 8,012 | 8,049 | 8,085 | 8,122 | 8,159 | 8,195 | 8,232 | 8,269 | 9,305 |
| 5349 | 8,342 | 8,379 | 8,415 | 8,452 | 8,489 | 8,525 | 8,562 | 8,599 | 8,635 | 8,672 |
| 5350 | 8,709 | 8,750 | 8,791 | 8,832 | 8,873 | 8,914 | 8,955 | 8,996 | 9,037 | 9,078 |
| 5351 | 9,119 | 9,160 | 9,201 | 9,242 | 9,283 | 9,324 | 9,365 | 9,406 | 9,447 | 9,488 |
| 5352 | 9,529 | 9,570 | 9,611 | 9,652 | 9,693 | 9,734 | 9,775 | 9,816 | 9,857 | 9,898 |
| 5353 | 9,939 | 9,980 | 10,021 | 10,062 | 10,103 | 10,144 | 10,185 | 10,226 | 10,267 | 10,308 |
| 5354 | 10,349 | 10,390 | 10,431 | 10,472 | 10,513 | 10,554 | 10,595 | 10,636 | 10,677 | 10,718 |
| 5355 | 10,759 | 10,805 | 10,851 | 10,897 | 10,943 | 10,989 | 11,036 | 11,082 | 11,128 | 11,174 |
| 5356 | 11,220 | 11,266 | 11,312 | 11,359 | 11,405 | 11,451 | 11,497 | 11,543 | 11,589 | 11,636 |
| 5357 | 11,682 | 11,728 | 11,774 | 11,820 | 11,866 | 11,913 | 11,959 | 12,005 | 12,051 | 12,097 |
| 5358 | 12,143 | 12,190 | 12,236 | 12,282 | 12,328 | 12,374 | 12,420 | 12,466 | 12,513 | 12,559 |
| 5359 | 12,605 | 12,651 | 12,697 | 12,743 | 12,790 | 12,836 | 12,882 | 12,928 | 12,974 | 13,020 |
| 5360 | 13,067 | 13,119 | 13,171 | 13,224 | 13,276 | 13,329 | 13,381 | 13,433 | 13,486 | 13,538 |
| 5361 | 13,591 | 13,643 | 13,695 | 13,748 | 13,800 | 13,853 | 13,905 | 13,957 | 14,010 | 14,062 |
| 5362 | 14,115 | 14,167 | 14,219 | 14,272 | 14,324 | 14,377 | 14,429 | 14,481 | 14,534 | 14,586 |
| 5363 | 14,639 | 14,691 | 14,743 | 14,796 | 14,848 | 14,901 | 14,953 | 15,005 | 15,058 | 15,110 |
| 5364 | 15,163 | 15,215 | 15,267 | 15,320 | 15,372 | 15,425 | 15,477 | 15,529 | 15,582 | 15,634 |
| 5365 | 15,687 | 15,745 | 15,804 | 15,863 | 15,922 | 15,980 | 16,039 | 16,098 | 16,157 | 16,215 |
| 5366 | 16,274 | 16,333 | 16,392 | 16,450 | 16,509 | 16,568 | 16,627 | 16,685 | 16,744 | 16,803 |
| 5367 | 16,862 | 16,921 | 16,979 | 17,038 | 17,097 | 17,156 | 17,214 | 17,273 | 17,332 | 17,391 |
| 5368 | 17,449 | 17,508 | 17,567 | 17,626 | 17,684 | 17,743 | 17,802 | 17,861 | 17,919 | 17,978 |
| 5369 | 18,037 | 18,096 | 18,154 | 18,213 | 18,272 | 18,331 | 18,390 | 18,448 | 18,507 | 18,566 |
| 5370 | 18,625 | 18,691 | 18,758 | 18,825 | 18,892 | 18,959 | 19,026 | 19,093 | 19,160 | 19,227 |
| 5371 | 19,294 | 19,360 | 19,427 | 19,494 | 19,561 | 19,628 | 19,695 | 19,762 | 19,829 | 19,896 |
| 5372 | 19,963 | 20,029 | 20,096 | 20,163 | 20,230 | 20,297 | 20,364 | 50,431 | 20,498 | 20,565 |
| 5373 | 20,632 | 20,698 | 20,765 | 20,832 | 20,899 | 20,966 | 21,033 | 21,100 | 21,167 | 21,234 |
| 5374 | 21,301 | 21,367 | 61,434 | 21,501 | 21,568 | 21,635 | 21,702 | 21,769 | 21,836 | 21,903 |
| 5375 | 21,970 | 22,047 | 22,124 | 22,201 | 22,279 | 22,356 | 22,433 | 22,511 | 22,588 | 22,665 |

TABLE 3. TOTAL STORAGE IN ACRE-FEET (continued)

RUBY RESERVOIR

| Elevation | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 5376 | 22,743 | 22,820 | 22,897 | 22,974 | 23,052 | 23,129 | 23,206 | 23,284 | 23,361 | 23,438 |
| 5377 | 23,516 | 23,593 | 23,670 | 23,747 | 23,825 | 23,902 | 23,979 | 24,057 | 24,134 | 24,211 |
| 5378 | 24,289 | 24,366 | 24,443 | 24,520 | 24,598 | 24,675 | 24,752 | 24,830 | 24,907 | 24,984 |
| 5379 | 25,062 | 25,139 | 25,216 | 25,293 | 25,371 | 25,448 | 25,525 | 25,603 | 25,680 | 25,757 |
| 5380 | 25,835 | 25,920 | 26,006 | 26,092 | 26,177 | 26,263 | 26,349 | 26,434 | 26,520 | 26,605 |
| 5381 | 26,691 | 26,777 | 26,862 | 26,948 | 27,034 | 27,119 | 27,205 | 27,291 | 27,376 | 27,462 |
| 5382 | 27,548 | 27,633 | 27,719 | 27,805 | 27,890 | 27,976 | 28,062 | 28,147 | 28,233 | 28,319 |
| 5383 | 28,404 | 28,490 | 28,576 | 28,661 | 28,747 | 28,833 | 28,918 | 29,004 | 29,090 | 29,175 |
| 5384 | 29,261 | 29,347 | 29,432 | 29,518 | 29,604 | 29,689 | 29,775 | 29,861 | 29,946 | 30,032 |
| 5385 | 30,118 | 30,209 | 30,301 | 30,393 | 30,484 | 30,576 | 30,668 | 30,759 | 30,851 | 30,943 |
| 5386 | 31,035 | 31,126 | 31,218 | 31,310 | 31,401 | 31,493 | 31,585 | 31,676 | 31,768 | 31,860 |
| 5387 | 31,952 | 32,043 | 32,135 | 32,227 | 32,318 | 32,410 | 32,502 | 32,593 | 32,685 | 32,777 |
| 5388 | 32,869 | 32,960 | 33,052 | 33,144 | 33,235 | 33,327 | 33,419 | 33,510 | 33,602 | 33,694 |
| 5389 | 33,786 | 33,877 | 33,969 | 34,061 | 34,152 | 34,244 | 34,336 | 34,427 | 34,519 | 34,611 |
| 5390 | 34,703 | 34,799 | 34,896 | 34,992 | 35,089 | 35,185 | 35,282 | 35,378 | 35,475 | 35,571 |
| 5391 | 35,668 | 35,764 | 35,861 | 35,957 | 36,054 | 36,150 | 36,247 | 36,343 | 36,440 | 36,536 |
| 5392 | 36,633 | 36,734 | 36,834 | 36,935 | 37,036 | 37,137 | 37,238 | 37,339 | 37,440 | 37,541 |
| 5393 | 37,642 | 37,743 | 37,844 | 37,945 | 38,046 | 38,147 | 38,248 | 38,349 | 38,450 | 38,551 |
| 5394 | 38,652 | 38,753 | 38,854 | 38,955 | 39,056 | 39,157 | 39,258 | 39,359 | 39,460 | 39,561 |
| 5395 | 39,662 | 39,771 | 39,880 | 39,989 | 40,098 | 40,207 | 40,316 | 40,425 | 40,534 | 40,643 |
| 5396 | 40,752 | 40,861 | 40,970 | 41,079 | 41,188 | 41,297 | 41,407 | 41,516 | 41,625 | 41,734 |
| 5397 | 41,843 | 41,952 | 42,061 | 42,170 | 42,279 | 42,388 | 42,497 | 42,606 | 42,715 | 42,824 |
| 5398 | 42,933 | 43,042 | 43,151 | 43,261 | 43,370 | 43,479 | 43,588 | 43,697 | 43,806 | 43,915 |
| 5399 | 44,024 | 44,133 | 44,242 | 44,351 | 44,460 | 44,569 | 44,678 | 44,787 | 44,896 | 45,005 |
| 5400 | 45,115 | 45,233 | 45,351 | 45,469 | 45,587 | 45,705 | 45,824 | 45,942 | 46,060 | 46,178 |
| 5401 | 46,296 | 46,414 | 46,532 | 46,651 | 46,869 | 46,887 | 47,005 | 47,123 | 47,241 | 47,360 |
| 5402 | 47,478 | 47,596 | 47,714 | 47,832 | 47,950 | 48,069 | 48,187 | 48,305 | 48,423 | 48,541 |
| 5403 | 48,659 | 48,778 | 48,896 | 49,014 | 49,132 | 49,250 | 49,368 | 49,486 | 49,605 | 49,723 |
| 5404 | 49,841 | 49,959 | 50,077 | 50,195 | 50,314 | 50,432 | 50,550 | 50,668 | 50,786 | 50,904 |
| 5405 | 51,023 | 51,150 | 51,276 | 51,403 | 51,530 | 51,657 | 51,784 | 51,911 | 52,038 | 52,165 |
| 5406 | 52,292 | 52,419 | 52,546 | 52,673 | 52,800 | 52,927 | 53,054 | 53,181 | 53,308 | 53,435 |
| 5407 | 53,562 | 53,689 | 53,816 | 53,943 | 54,070 | 54,197 | 54,324 | 54,450 | 54,577 | 54,704 |
| 5408 | 54,831 | 54,958 | 55,085 | 55,212 | 55,339 | 55,466 | 55,593 | 55,720 | 55,847 | 55,974 |
| 5409 | 56,101 | 56,228 | 56,355 | 56,482 | 56,609 | 56,736 | 56,863 | 56,990 | 57,117 | 57,244 |
| 5410 | | | | | | | | | | |

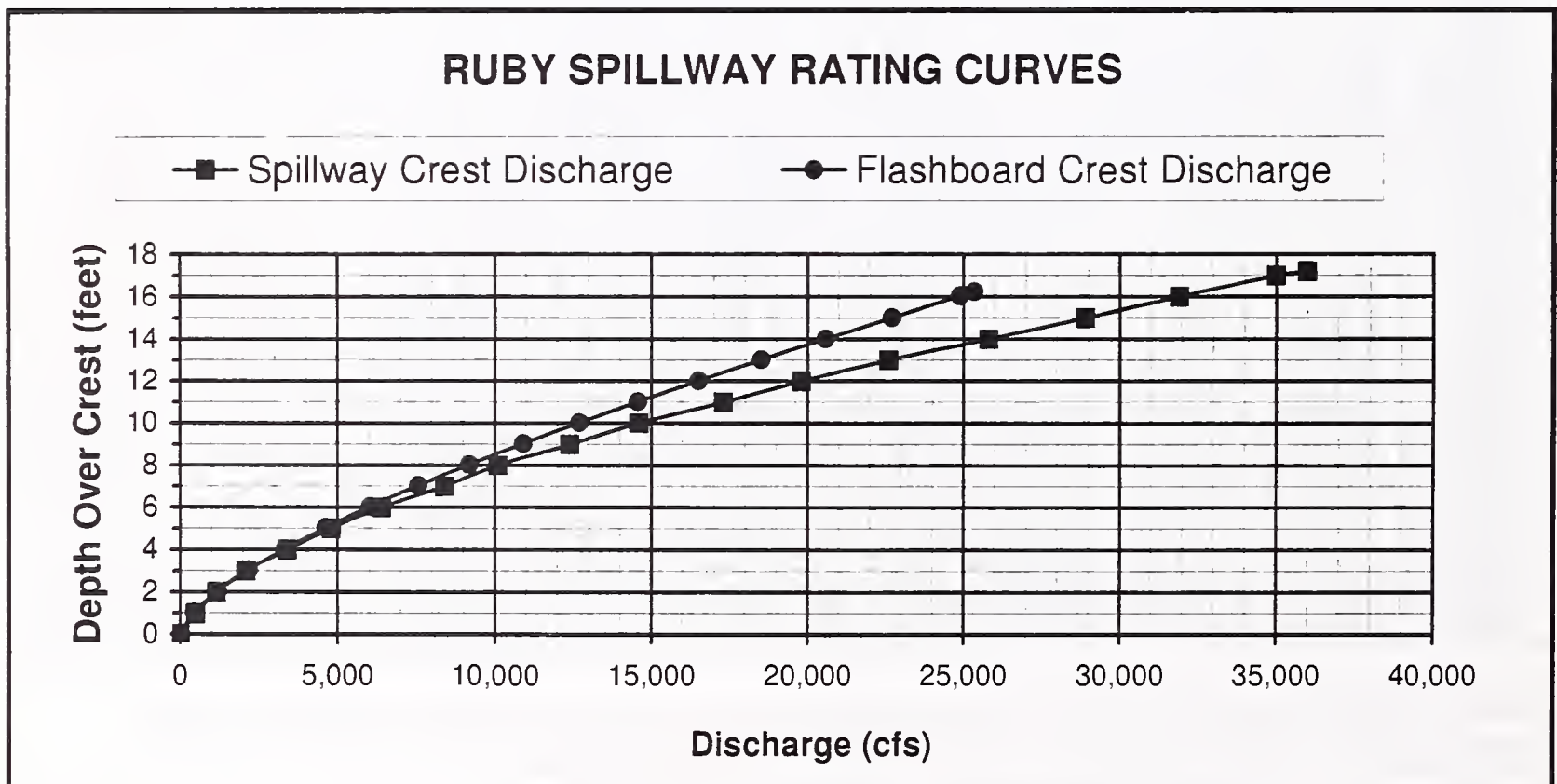
Note: Storage volumes based upon new topographic surveys and maps completed in 1994.

Spillway Crest Elevation 5,392.0 feet Storage 36,633 acre-feet

Dam Crest Elevation 5,409.2 feet Storage 56,355 acre-feet

TABLE 4. SPILLWAY DISCHARGE
RUBY RESERVOIR

| Elevation (feet) | Concrete Spillway Crest | | Flashboard Crest | |
|---------------------|----------------------------------|--------------------|------------------------------------|--------------------|
| | Depth Over Spillway (feet) | Discharge (cfs) | Depth Over Flashboard (feet) | Discharge (cfs) |
| 5392 | 0 | 0 | | |
| 5392.97 | 0.97 | 478 | 0 | 0 |
| 5393 | 1 | 500 | 0.03 | 2 |
| 5394 | 2 | 1,150 | 1.03 | 435 |
| 5395 | 3 | 2,100 | 2.03 | 1,204 |
| 5396 | 4 | 3,400 | 3.03 | 2,184 |
| 5397 | 5 | 4,800 | 4.03 | 3,333 |
| 5398 | 6 | 6,400 | 5.03 | 4,627 |
| 5399 | 7 | 8,400 | 6.03 | 6,041 |
| 5400 | 8 | 10,100 | 7.03 | 7,563 |
| 5401 | 9 | 12,400 | 8.03 | 9,196 |
| 5402 | 10 | 14,600 | 9.03 | 10,908 |
| 5403 | 11 | 17,300 | 10.03 | 12,698 |
| 5404 | 12 | 19,800 | 11.03 | 14,575 |
| 5405 | 13 | 22,600 | 12.03 | 16,508 |
| 5406 | 14 | 25,800 | 13.03 | 18,520 |
| 5407 | 15 | 28,900 | 14.03 | 20,581 |
| 5408 | 16 | 31,900 | 15.03 | 22,696 |
| 5409 | 17 | 35,000 | 16.03 | 24,870 |
| 5409.2 | 17.2 | 36,000 | 16.23 | 25,337 |



Note: Data from the Corps of Engineers Phase 1 Inspection Report (1980).

APPENDIX C
INSPECTION REPORT FORM

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DAM SAFETY INSPECTION REPORT

NAME OF DAM _____
DATE INSPECTED _____

INVENTORY NO. _____
HAZARD CATEGORY _____
TYPE OF DAM _____
YEAR BUILT _____

OWNER _____
OPERATOR _____
STREAM _____
DRAINAGE AREA _____

Reservoir Storage Status

| | Water Surface Elevation (feet) | Storage (acre-feet) |
|-----------------------------|-----------------------------------|------------------------|
| At time of inspection | _____ | |
| At spillway crest | _____ | |
| At min. dam crest elevation | _____ | |

| ITEM | YES | NO | REMARKS |
|------|-----|----|---------|
|------|-----|----|---------|

1. EMBANKMENT

A. Crest -- Height= Length= Width=

| | | | |
|-----------------------------|--|--|--|
| (1) Any visual settlements? | | | |
| (2) Any misalignments? | | | |
| (3) Any cracking? | | | |
| (4) Any traffic damage? | | | |
| (5) Other? | | | |

| ITEM | YES | NO | REMARKS |
|------|-----|----|---------|
|------|-----|----|---------|

1. EMBANKMENT (continued)

B. Upstream Face -- Slope=

| | | | |
|--|--|--|--|
| (1) Any erosion? | | | |
| (2) Any longitudinal cracks? | | | |
| (3) Any transverse cracks? | | | |
| (4) Is riprap protection adequate? | | | |
| (5) Any stone deterioration? | | | |
| (6) Any visual settlement, slumps, sloughing, depressions or bulges? | | | |
| (7) Adequate grass cover? | | | |
| (8) Debris on the dam face? | | | |
| (9) Other? | | | |

C. Downstream Face--Slope=

| | | | |
|--|--|--|--|
| (1) Any erosion? | | | |
| (2) Any longitudinal cracks? | | | |
| (3) Any transverse cracks? | | | |
| (4) Any visual settlement, slumps, sloughing, depressions or bulges? | | | |
| (5) Is the toe drain dry? | | | |
| (6) Are the relief wells flowing? | | | |
| (7) Any boils at the toe? | | | |
| (8) Any seepage areas? | | | |
| (9) Any traffic or animal damage? | | | |
| (10) Any burrowing animals? | | | |
| (11) Adequate grass cover? | | | |
| (12) Other? | | | |

D. Amount and Type of Vegetation on the Dam

| |
|--|
| |
|--|

| ITEM | YES | NO | REMARKS |
|------|-----|----|---------|
|------|-----|----|---------|

2. ABUTMENT CONTACTS

| | | | |
|--------------------------------------|--|--|--|
| A) Any erosion? | | | |
| B) Any visual differential movement? | | | |
| C) Any cracks? | | | |
| D) Any seepage present? | | | |
| E) Other? | | | |

3. OUTLET WORKS

A. Intake Structure -- Size=

| | | | |
|--------------------------------|--|--|--|
| (1) Any settlement? | | | |
| (2) Any tilting? | | | |
| (3) Do concrete surfaces show: | | | |
| a. Spalling? | | | |
| b. Cracking? | | | |
| c. Erosion? | | | |
| d. Exposed reinforcement? | | | |
| (4) Do joints show: | | | |
| a. Displacement or offset? | | | |
| b. Loss of joint material? | | | |
| c. Leakage? | | | |
| (5) Metal appurtenances: | | | |
| a. Any corrosion present? | | | |
| b. Any breakage present? | | | |
| (6) Trash rack? | | | |
| a. Condition? | | | |
| b. Anchor system secure? | | | |
| (7) Other? | | | |

| ITEM | YES | NO | REMARKS |
|------|-----|----|---------|
|------|-----|----|---------|

3. OUTLET WORKS (continued)

B. Conduit -- Type = _____ Size = _____

| | | | |
|----------------------------------|--|--|--|
| (1) Do concrete surfaces show: | | | |
| a. Spalling? | | | |
| b. Cracking? | | | |
| c. Erosion? | | | |
| d. Exposed reinforcement? | | | |
| (2) Do joints show: | | | |
| a. Displacement or offset? | | | |
| b. Loss of joint material? | | | |
| c. Leakage? | | | |
| (3) Is the conduit metal? | | | |
| a. Any corrosion present? | | | |
| b. Protective coatings adequate? | | | |
| (4) Is the conduit misaligned? | | | |
| (5) Any calcium deposits? | | | |
| (6) Other? | | | |

C. Gates and Tower

| | | | |
|--|--|------------|--|
| (1) Gates: | | | |
| a. Size: Operating: | | Emergency: | |
| b. Type: Operating: | | Emergency: | |
| (2) Controls operational? | | | |
| (3) Controls lubricated? | | | |
| (4) Operational problems? | | | |
| (5) Leakage around gates? | | | |
| (6) Condition of gate seals? | | | |
| (7) Any cavitation damage? If so, describe? | | | |
| (8) Describe air vent-size and condition. | | | |

| ITEM | YES | NO | REMARKS |
|------|-----|----|---------|
|------|-----|----|---------|

3. OUTLET WORKS (continued)

C. Gates and Tower (continued)

| | | | |
|--|--|--|--|
| (9) Is there a jet pump? | | | |
| a. Is it operational? | | | |
| b. Leakage? | | | |
| (10) Is the tower dry? _____ wet? | | | |
| (11) Any seepage in the tower? | | | |
| (12) Condition of the tower? | | | |
| (13) Any safety problems? | | | |
| (14) Ladder in good condition? | | | |
| (15) Condition of the gatehouse? | | | |
| (16) Emergency plan completed for the dam? | | | |
| a. Posted in the gatehouse? | | | |
| (17) Other? | | | |

D. Stilling Basin

| | | | |
|----------------------------------|--|--|--|
| (1) Do concrete surfaces show: | | | |
| a. Spalling? | | | |
| b. Cracking? | | | |
| c. Erosion? | | | |
| d. Exposed reinforcement? | | | |
| (2) Do joints show: | | | |
| a. Displacement or offset? | | | |
| b. Loss of joint material? | | | |
| c. Leakage? | | | |
| (3) Do energy dissipaters show: | | | |
| a. Signs of deterioration? | | | |
| b. Are they covered with debris? | | | |
| (4) Other? | | | |

| ITEM | YES | NO | REMARKS |
|------|-----|----|---------|
|------|-----|----|---------|

3. OUTLET WORKS (continued)

E. Downstream Channel

| | | | |
|-----------------------------|--|--|--|
| (1) Is the channel: | | | |
| a. Eroding or backcutting? | | | |
| b. Sloughing? | | | |
| c. Obstructed? | | | |
| (2) Is released water: | | | |
| a. Undercutting the outlet? | | | |
| b. Eroding the embankment? | | | |
| (3) Other? | | | |

4. SPILLWAY

A. Description

| | | | |
|--|--|--|--|
| (1) Location? | | | |
| (2) Type of Spillway? | | | |
| (3) Size of Spillway? | | | |
| (4) Spillway lining? | | | |
| (5) Is there a weir? | | | |
| (6) Is the spillway in good condition? | | | |
| (7) Any drains? | | | |
| a. Describe the condition of drains. | | | |

B. Does spillway show:

| | | | |
|--|--|--|--|
| (1) Any cracking concrete? | | | |
| (2) Any spalling concrete? | | | |
| (3) Any exposed reinforcement in the concrete? | | | |
| (4) Any erosion? | | | |

| ITEM | YES | NO | REMARKS |
|------|-----|----|---------|
|------|-----|----|---------|

4. SPILLWAY (continued)

4. B. Does spillway show: (continued)

| | | | |
|------------------------------------|--|--|--|
| (5) Any slope sloughing? | | | |
| (6) Any obstructions? | | | |
| (7) Displacement or offset joints? | | | |
| (8) Loss of joint material? | | | |
| (9) Leakage at the joints? | | | |
| (10) Other? | | | |

C. Do the energy dissipaters show:

| | | | |
|-----------------------------------|--|--|--|
| (1) Signs of deterioration? | | | |
| (2) Any cracking? | | | |
| (3) Any spalling? | | | |
| (4) Any exposed reinforcement? | | | |
| (5) Are they covered with debris? | | | |
| (6) Other? | | | |

D. Has release water:

| | | | |
|------------------------------------|--|--|--|
| (1) Eroded the embankment? | | | |
| (2) Undercut the outlet? | | | |
| (3) Eroded the downstream channel? | | | |
| (4) Other? | | | |

E. Emergency Spillway

| | | | |
|-------------------------------------|--|--|--------------------|
| (1) Is there an emergency spillway? | | | (If YES, describe) |
| | | | |

| ITEM | YES | NO | REMARKS |
|------|-----|----|---------|
|------|-----|----|---------|

5. RESERVOIR CONTROL

| | | | |
|-----------------------------------|--|--|--|
| A) Recent upstream development? | | | |
| B) Recent downstream development? | | | |
| C) Slides in reservoir area? | | | |
| D) Change in reservoir operation? | | | |
| E) Large impoundment upstream? | | | |
| F) Any debris in the reservoir? | | | |
| G) Other? | | | |

6. INSTRUMENTATION

| | | | |
|---|--|--|--|
| A) List type(s) of instrumentation: | | | |
| B) In good condition? | | | |
| C) Read periodically? | | | |
| D) Is data available? | | | |
| E) Include all data gathered since last report. | | | |

7. DOWNSTREAM CONDITION

A. Downstream Land Use.

| |
|--|
| |
|--|

This dam was inspected by:

Additional comments and recommendations.

APPENDIX D
O&M MANUAL DISTRIBUTION LIST

O&M MANUAL DISTRIBUTION LIST

RUBY DAM

| | <u>Number Of Copies</u> |
|--|-----------------------------|
| 1. State Water Project Bureau Glen McDonald Greg Ames Art Taylor (2) Bob Arrington Bob Clark Delores Eustice | 7 |
| 2. DNRC Information Services Section | 1 |
| 3. DNRC Bozeman Regional Office Scott Compton | 1 |
| 4. DNRC Dam Safety | 1 |
| 5. Water Users Dan Doornbos - President Jim Anderson - Vice President Neil Todd - Secretary/Dam Operator/Ditchrider Copy for Gatehouse | 4 |
| 6. State Library - Attn: Roberta Gebhardt | 4 |
| 7. Extra | 2 |
| <hr/> Total | <hr/> 20 |

APPENDIX E

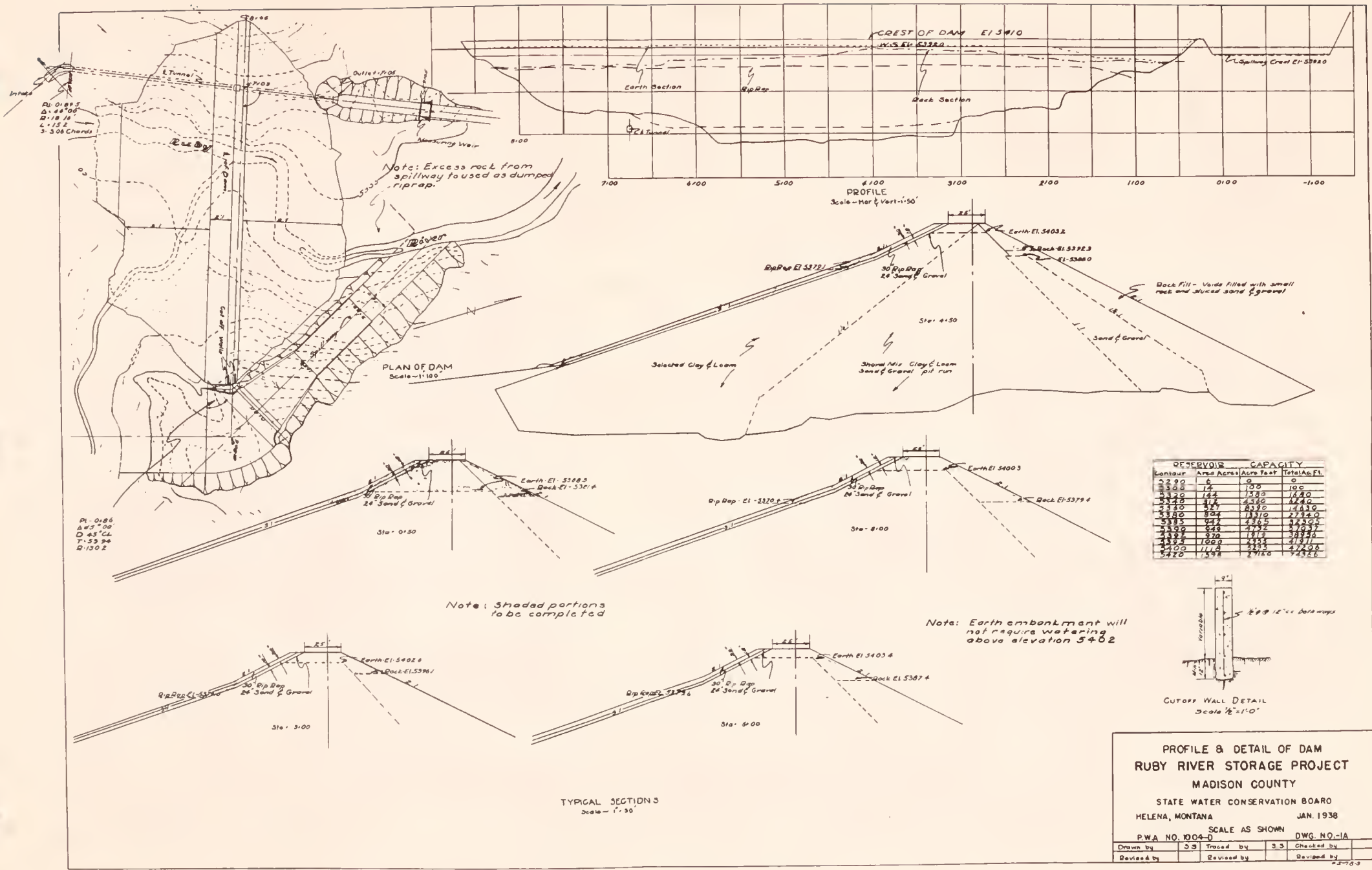
MONITORING WELL LOGS

(NOTE: The monitoring well logs have not been prepared as of this printing. The well logs will be added in the future when they are prepared.)

APPENDIX F

PROJECT DRAWINGS

(NOTE: These reduced project drawings are design drawings and not "As Builts". These drawing should be used for reference only. The SWPB has the full size project drawings.)

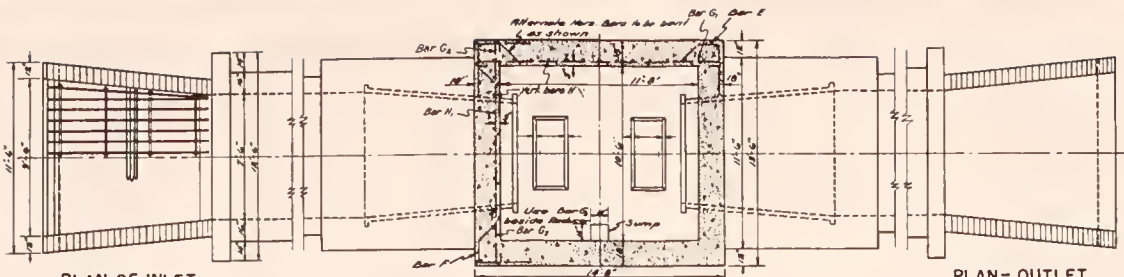


PROFILE & DETAIL OF DAM
RUBY RIVER STORAGE PROJECT
MADISON COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONTANA
JAN. 1938

SCALE AS SHOWN
P.W.A. NO. 1004-D
DWG. NO. -1A

| | | | | | |
|------------|----|------------|----|------------|--|
| Drawn by | 53 | Traced by | 53 | Checked by | |
| Revised by | | Revised by | | Revised by | |

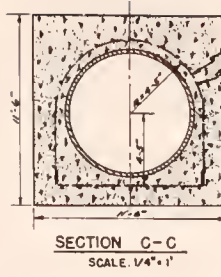
CONSTRUCTION JOINTS
SCALE: 1/2" = 1'



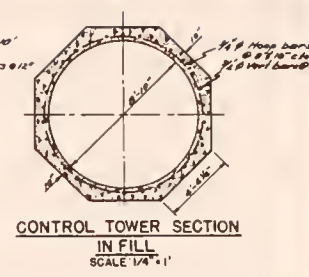
PLAN OF INLET
SCALE: 1/4" = 1'

CONTROL CHAMBER SECTION A-A
SCALE: 1/4" = 1'

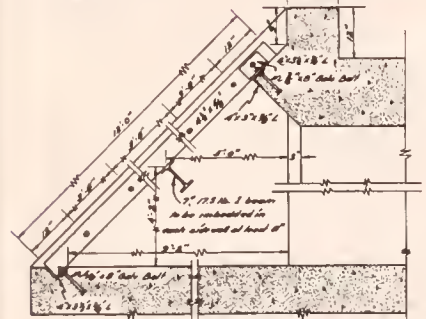
PLAN - OUTLET
SCALE: 1/4" = 1'



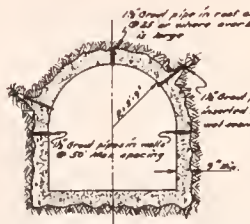
SECTION C-C
SCALE: 1/4" = 1'



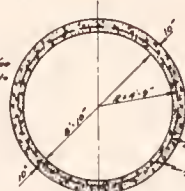
CONTROL TOWER SECTION IN FILL
SCALE: 1/4" = 1'



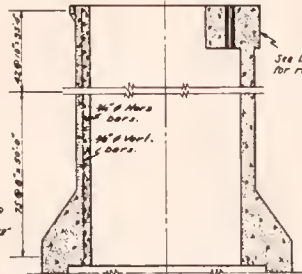
TRASH RACK DETAIL
SCALE: 3/4" = 1'



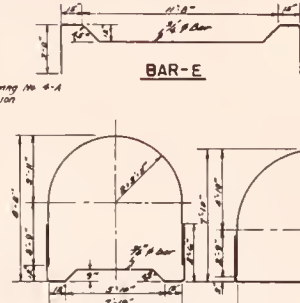
TUNNEL CONDUIT SECTION
SHOWING TYPICAL SECTION WHERE WET SEAMS ARE ENCOUNTERED.
SCALE: 1/4" = 1'



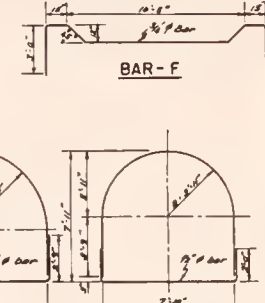
CONTROL TOWER SECTION IN ROCK



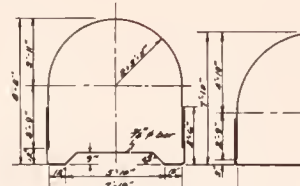
CONTROL TOWER SECTIONAL ELEV.
SCALE: 1/4" = 1'



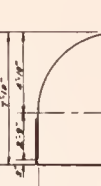
BAR - E



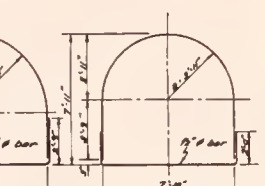
BAR - F



BAR - A

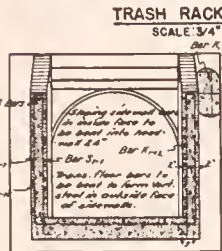


BAR - B

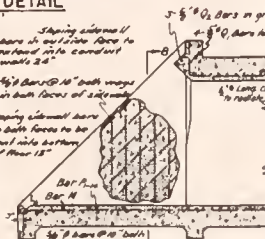


BAR - C

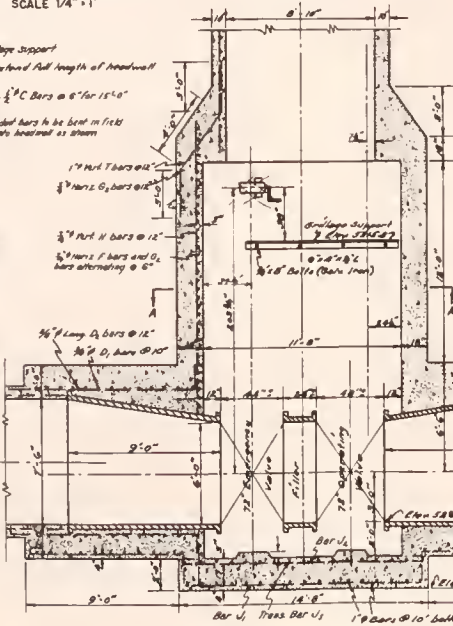
Note: In the present design there will be no Open Conduit Section as Bar A and Bar C will be omitted.



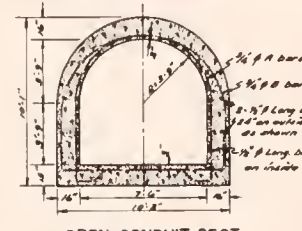
SECTION B-B
SCALE: 1/4" = 1'



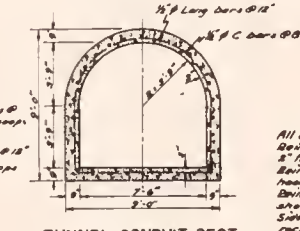
SIDE ELEVATION - INLET
SCALE: 1/4" = 1'



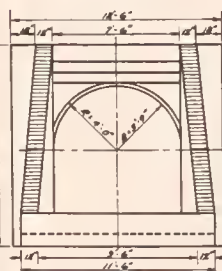
SECTIONAL ELEVATION - CONTROL CHAMBER
SCALE: 1/4" = 1'



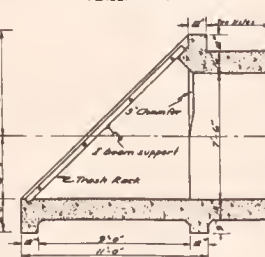
OPEN CONDUIT SECT.
SCALE: 1/4" = 1'



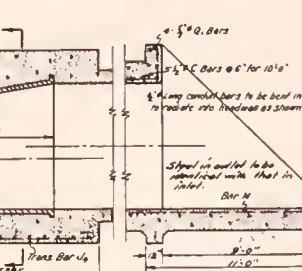
TUNNEL CONDUIT SECT.
SCALE: 1/4" = 1'



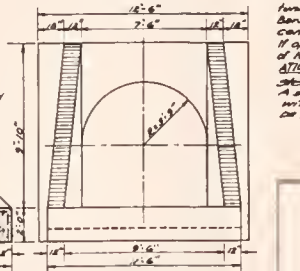
END ELEVATION - INLET
SCALE: 1/4" = 1'



SIDE ELEVATION - INLET
SCALE: 1/4" = 1'



SIDE ELEVATION - OUTLET
SCALE: 1/4" = 1'



END ELEVATION - OUTLET
SCALE: 1/4" = 1'

GENERAL NOTES

All concrete edges to be chamfered 1/2" Reinforcing steel to be placed a minimum distance of 2" from surface of concrete.

Reinforcing steel with hooked ends to be bent in a hook of minimum of 5 diameters.

Reinforcing steel to lap 40 diameters, unless otherwise shown.

Side walls of inlet and outlet structures to be cast against rock.

Conduit section with 1/8" walls to extend from headwall of inlet structure a distance of 10' into tunnel and from headwall of outlet structure a distance of 10' into tunnel.

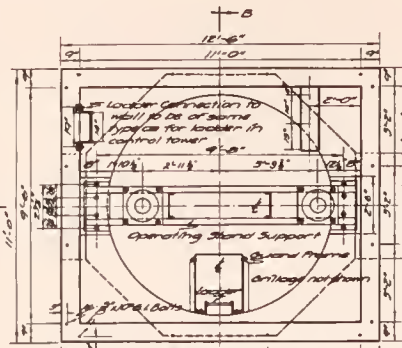
Bars E and bars F to be placed in alternate lines in central chamber walls.

If opening stem of emergency valve is carried to top of tower, grillage support as shown in SECTIONAL ELEVATION - CONTROL CHAMBER will be omitted.

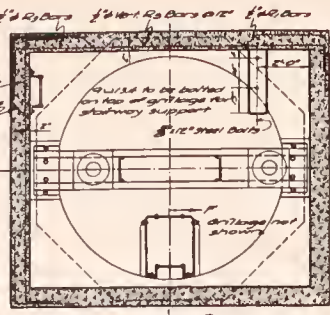
Shooper keys in control tower hoop bars A set of G1 bars will be placed in the same bar with a set of E bars and a set of D bars will be placed in the same bar with a set of F bars.

CONTROL WORKS
DETAILS OF OUTLET STRUCTURE
RUBY RIVER STORAGE PROJECT
MADISON COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONT. NOV. 21, 1936
SCALE AS SHOWN
P.W.A. NO. 100-A-D DRAWING NO. 3

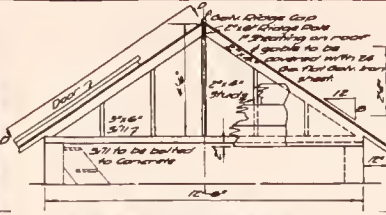




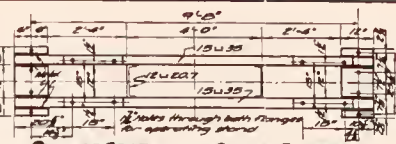
PLAN OF GATE HOUSE
Scale 1/8" = 1'-0"



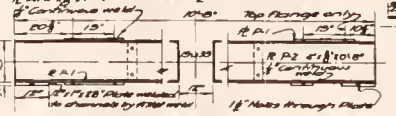
SECTION C-C
Scale 1/8" = 1'-0"



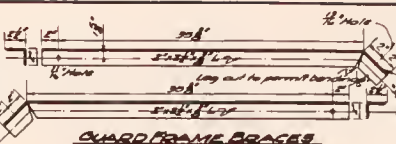
END VIEW GATE HOUSE ROOF
Scale 1/8" = 1'-0"



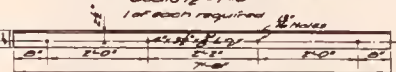
PLAN OF OPERATING STAND SUPPORT
Scale 1/8" = 1'-0"



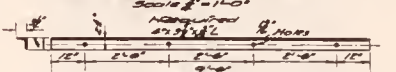
ELEVATION OF OPERATING STAND SUPPORT
Scale 1/8" = 1'-0"



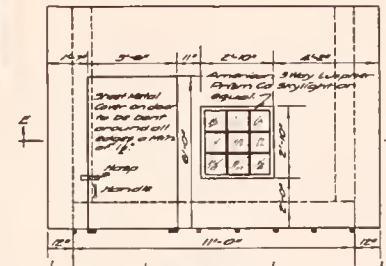
GUARD FRAME BRACES
Scale 1/8" = 1'-0"



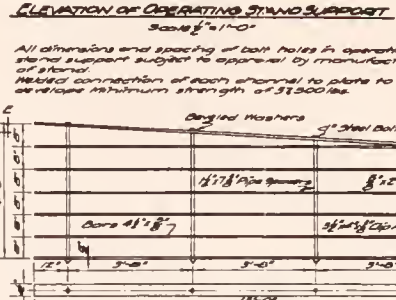
TOP TRASH RACK SUPPORT
Scale 1/8" = 1'-0"



BOTTOM TRASH RACK SUPPORT
Scale 1/8" = 1'-0"



VIEW D-D
Scale 1/8" = 1'-0"



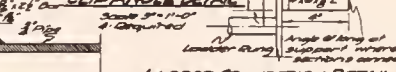
TRASH RACK CHULLAGE
HALF PLAN
Scale 1/8" = 1'-0"



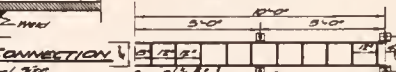
PLAN



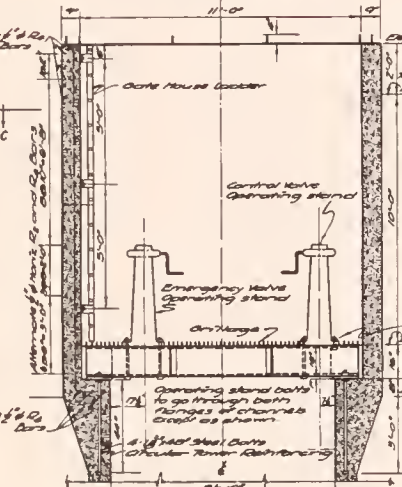
ELEVATION



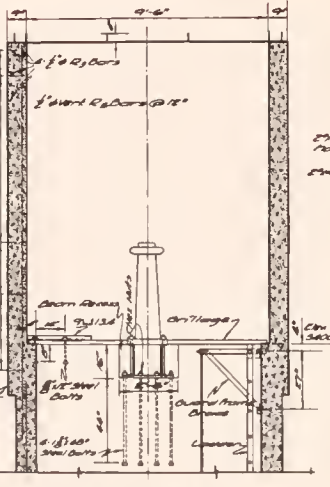
CLIP ANGLE DETAIL



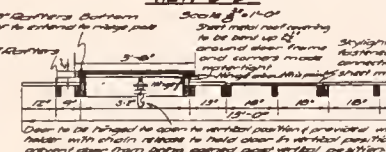
LADDER CONNECTION DETAIL
Scale 3/4" = 1'-0"



SECTION A-A
Scale 1/8" = 1'-0"



SECTION B-B
Scale 1/8" = 1'-0"



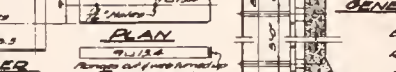
SECTION E-E
Scale 1/8" = 1'-0"



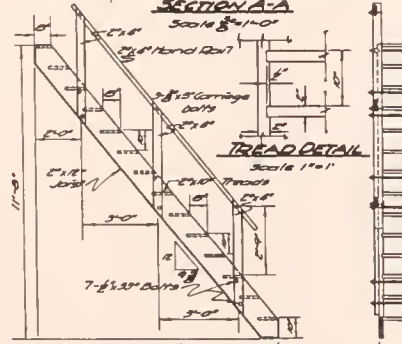
GATE HOUSE LADDER
Scale 1/8" = 1'-0"



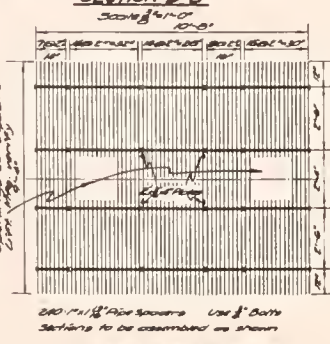
PLAN



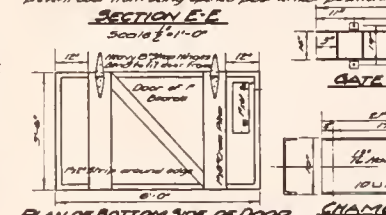
ELEVATION



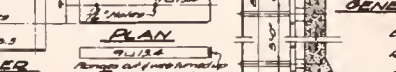
STAIRWAY DETAILS
Scale 1/8" = 1'-0"



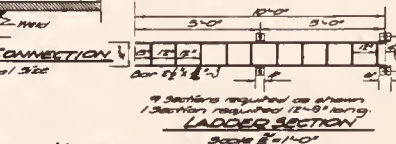
GATE HOUSE CHULLAGE
Scale 1/8" = 1'-0"



PLAN OF BOTTOM SIDE OF DOOR CHAMBER LADDER SUPPORT
Scale 1/8" = 1'-0"



PLAN OF GUARD FRAME AND LADDER
Scale 1/8" = 1'-0"



RING CONNECTION

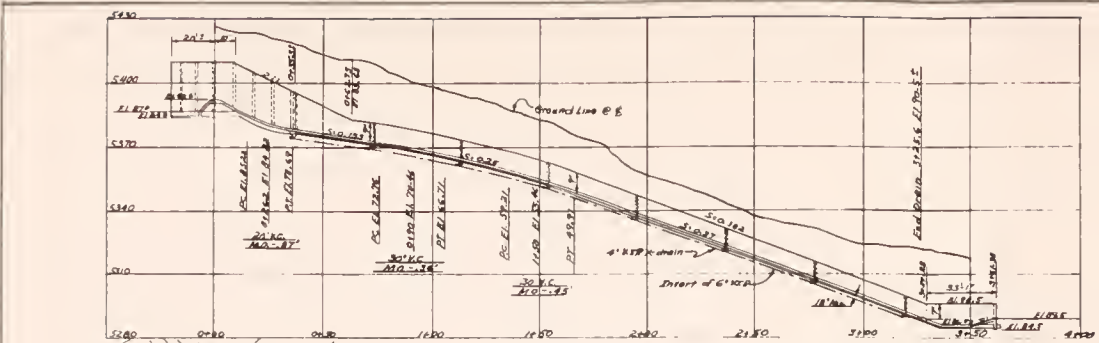
GENERAL NOTES

Edges of concrete to be chamfered 1/4"
Reinforcing steel to be placed 2" min. distance of 2" from surface of concrete unless otherwise shown.
Locker to be finished in place of stonework if present in gate house.
Gate house door to be constructed so that it will not enter an open frame.
All edges of concrete and steelwork on roof and door to be rounded or finished in a manner to prevent injury.
Roofs on trash rack chullage and all other between upper side of door and all to be made with equivalent thickness of roofing etc. holes in angle or angles and in other similar sections to be punched 3/16" standard gauge unless noted otherwise.
Ties of R₁ and R₂ bars to terminate with bars of R₂ and R₃ bars.
Structural steel to receive one steel coat and one fire coat of red lead and oil.

GATE HOUSE LADDER & TRASH RACK DETAILS

QUIY RIVER STORAGE PROJECT
MADISON COUNTY
STATE WATER CONSERVATION BOARD
MARIETTA, MOBILE
DWA 12/16/73
DWA 12/16/73
DWA 12/16/73





SPILLWAY CREST DATA

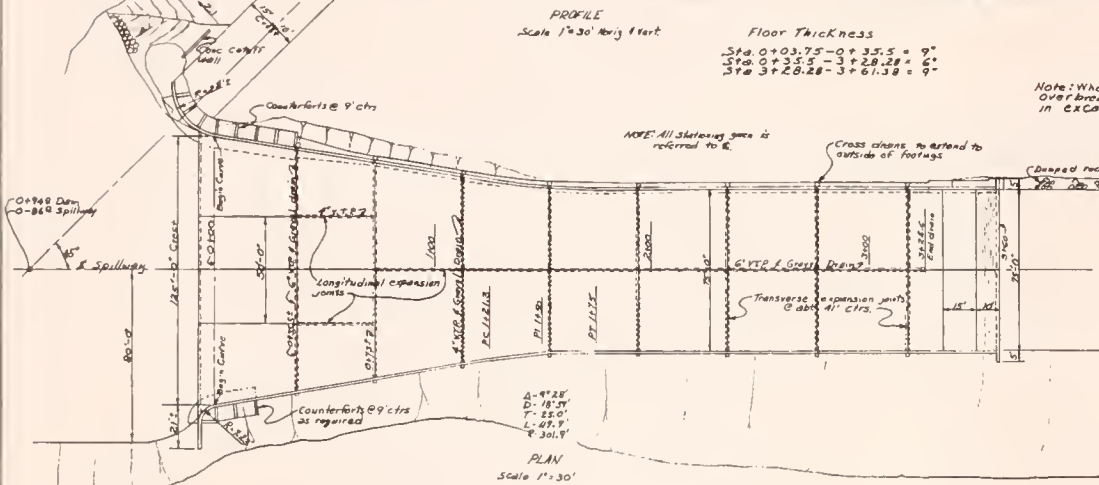
| Station | Elevation |
|---------|-----------|
| -0+02.8 | 5391.43 |
| -0+02.1 | 91.74 |
| -0+01.4 | 91.92 |
| -0+00.7 | 91.99 |
| 0+00.0 | 92.00 |
| 0+00.7 | 91.96 |
| 0+01.4 | 91.86 |
| 0+02.1 | 91.74 |
| 0+02.8 | 91.55 |
| 0+03.5 | 91.36 |
| 0+04.2 | 91.09 |
| 0+04.9 | 90.81 |
| 0+05.6 | 90.52 |
| 0+06.3 | 90.18 |
| 0+07.0 | 89.83 |

SPILLWAY HYDRAULICS

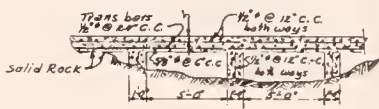
Q: 30,000 cfs (Q: CLN 1/2)
 C: 4.0
 Crest width: 125' 0"
 H: 15.33
 n: 0.015
 W.S. in Res.: 5407.33
 El. Crest: 5392.0
 Top Dam: 5400.0
 Drainage Area: 560 sq. miles

SPILLWAY DATA

| Station | Point | Elevation | | Width |
|---------|--------|-----------|----------|--------|
| | | 50' Floor | Top Wall | |
| 0+00.0 | Crest | 5392.2 | 5400.0 | 125' |
| 0+10.0 | | 89.83 | 5410.0 | 122.67 |
| 0+10.0 | | | 5400.0 | |
| 0+16.2 | Gr. PC | 83.82 | | 100.26 |
| 0+22.2 | Gr. PI | 81.09 | | 116.25 |
| 0+36.2 | Gr. PT | 78.79 | | 112.93 |
| 0+40 | | 78.12 | | 111.56 |
| 0+50 | | 76.59 | | 108.34 |
| 0+62.8 | | | 83.63 | |
| 0+75 | Gr. PC | 72.76 | 81.76 | 100.00 |
| 0+90 | Gr. PI | 70.10 | 79.10 | 95.00 |
| 1+05 | Gr. PT | 68.77 | 75.77 | 90.00 |
| 1+21.3 | PC | | | 82.30 |
| 1+35 | Gr. PC | 59.21 | 68.21 | 80.46 |
| 1+50 | Gr. PI | 55.01 | 64.01 | 77.22 |
| 1+65 | Gr. PT | 49.91 | 58.91 | 72.98 |
| 1+75 | PT | | | 75.00 |
| 2+00 | | 36.86 | 45.82 | |
| 2+50 | | 18.46 | 26.41 | |
| 3+00 | | 9.96 | | |
| 3+28.28 | | | 26.5 | |
| 3+36.38 | | | 26.5 | |
| 3+43.38 | | | 26.5 | |
| 3+50.38 | | | 26.5 | |
| 3+61.38 | | | 26.5 | |

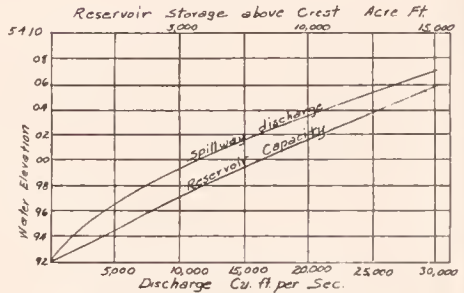


Note: Where 6" floor is used 3" overbreak will be allowed in excavation & concrete

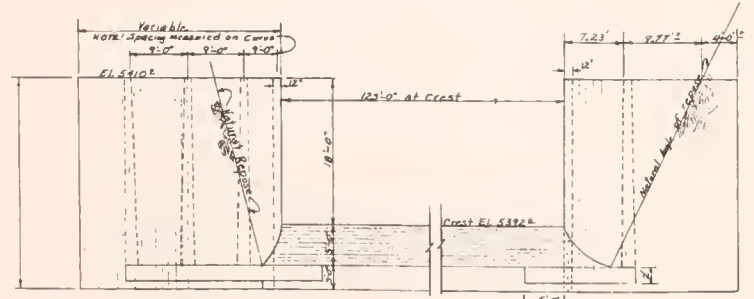


SECTION OF FLOOR Scale 1/4"=12"

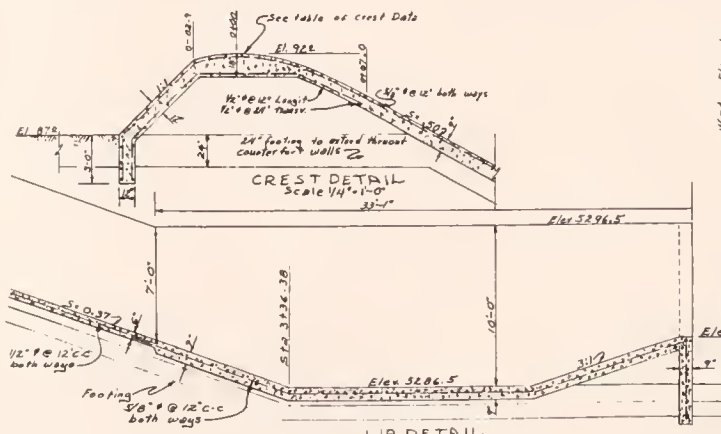
Note: To be used when Spillway floor is not on solid rock



Curves Showing Spillway Discharge and Reservoir Capacity above Spillway Crest



UPSTREAM ELEVATION Scale 1/4"=12"



LIP DETAIL Scale 1/4"=1'-0"

PLAN AND PROFILE OF SPILLWAY
 RUBY RIVER STORAGE PROJECT
 MADISON COUNTY
 STATE WATER CONSERVATION BOARD
 HELENA MONTANA FEB. 8 1938
 PWA NO. 1008-D Dwg. No. 5-B
 Drawn By: [Signature] Checked By: [Signature]
 Revised By: [Signature] Revised By: [Signature] Revised By: [Signature]

